DATA TRANSLATION

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DT9847 Series User's Manual

First Edition
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This equipment has been tested and found to comply with CISPR EN55022 Class A and EN61000-6-1 requirements and also with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user will be required to correct the interference at his own expense.

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Note: This product was verified to meet FCC requirements under test conditions that included use of shielded cables and connectors between system components. It is important that you use shielded cables and connectors to reduce the possibility of causing interference to radio, television, and other electronic devices.

Canadian Department of Communications Statement

This digital apparatus does not exceed the Class A limits for radio noise emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le présent appareil numérique n'émet pas de bruits radioélectriques dépassant les limites applicables aux appareils numériques de la class A prescrites dans le Règlement sur le brouillage radioélectrique édicté par le Ministère des Communications du Canada.

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About this Manual

The first part of this manual describes how to install and set up your DT9847 Series module and device driver, and verify that your module is working properly.

The second part of this manual describes the features of the DT9847 Series modules, the capabilities of the DT9847 Series Device Driver, and how to program the DT9847 module using the DT-Open Layers for .NET Class Library™ software. Troubleshooting information is also provided.

Note: For information on checking system requirements, installing the software, and viewing the documentation, refer to the README file on the OMNI CD.

For more information on the class library, refer to the *DT-Open Layers for .NET Class Library User's Manual*. If you are using the DataAcq SDK or a software application to program your device, refer to the documentation for that software for more information.

Intended Audience

This document is intended for engineers, scientists, technicians, or others responsible for using and/or programming a DT9847 Series module for data acquisition operations in the Microsoft® Windows® XP, Windows Vista®, Windows 7, or Windows 8 operating system. It is assumed that you have some familiarity with data acquisition principles and that you understand your application.

How this Manual is Organized

This manual is organized as follows:

- Chapter 1, "Overview," describes the major features of the DT9847 Series module, as well as the supported software and accessories for the modules.
- Chapter 2, "Setting Up and Installing the Module," describes how to install a DT9847 Series module, how to apply power to the module, and how to configure the DT9847 Series Device Driver.
- Chapter 3, "Wiring Signals," describes how to wire signals to a DT9847 Series module.
- Chapter 4, "Verifying the Operation of a Module," describes how to verify the operation of a DT9847 Series module with the VIBpoint Framework application.
- Chapter 5, "Principles of Operation," describes all of the features of the DT9847 Series module and how to access them in your application.
- Chapter 6, "Supported Device Driver Capabilities," lists the data acquisition subsystems and the associated features accessible using the DT9847 Series Device Driver.
- Chapter 7, "Troubleshooting," provides information that you can use to resolve problems with the DT9847 Series module and DT9847 Series Device Driver, should they occur.

- Chapter 8, "Calibration," describes how to calibrate the analog I/O circuitry of the DT9847 module.
- Appendix A, "Specifications," lists the specifications of the DT9847 Series module.
- Appendix B, "Connector Pin Assignments and LED Status Indicators," lists the pin assignments of the connectors on the DT9847 Series module.
- Appendix C, "Powering OEM Modules," describes how to apply power to OEM modules.
- An index completes this manual.

Conventions Used in this Manual

The following conventions are used in this manual:

- Notes provide useful information or information that requires special emphasis, cautions provide information to help you avoid losing data or damaging your equipment, and warnings provide information to help you avoid catastrophic damage to yourself or your equipment.
- Items that you select or type are shown in **bold**.

Related Information

Refer to the following documents for more information on using the DT9847 Series module:

- *Benefits of the Universal Serial Bus for Data Acquisition.* This white paper describes why USB is an attractive alternative for data acquisition. It is available on the Data Translation web site (www.datatranslation.com).
- *DT-Open Layers for .NET User's Manual* (UM-22161). For programmers who are developing their own application programs using Visual C# or Visual Basic .NET, this manual describes how to use the DT-Open Layers for .NET Class Library to access the capabilities of Data Translation data acquisition devices.
- *DataAcq SDK User's Manual* (UM-18326). For programmers who are developing their own application programs using the Microsoft C compiler, this manual describes how to use the DT-Open Layers DataAcq SDK™ to access the capabilities of Data Translation data acquisition devices.
- *LV-Link Online Help*. This help file describes how to use LV-Link™ with the LabVIEW™ graphical programming language to access the capabilities of Data Translation data acquisition devices.
- Microsoft Windows XP, Windows Vista, Windows 7, or Windows 8 documentation.
- USB web site (http://www.usb.org).

Where To Get Help

Should you run into problems installing or using a DT9847 Series module, the Data Translation Technical Support Department is available to provide technical assistance. Refer to Chapter 7 for more information. If you are outside the United States or Canada, call your local distributor, whose number is listed on our web site (www.datatranslation.com).

Overview

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Hardware Features

DT9847 Series modules are high-accuracy, dynamic signal acquisition modules for the USB (Ver. 2.0 or Ver. 1.1) bus. These modules are ideal for noise, vibration, and acoustic measurements. Figure 1 shows the DT9847-3-1 module.

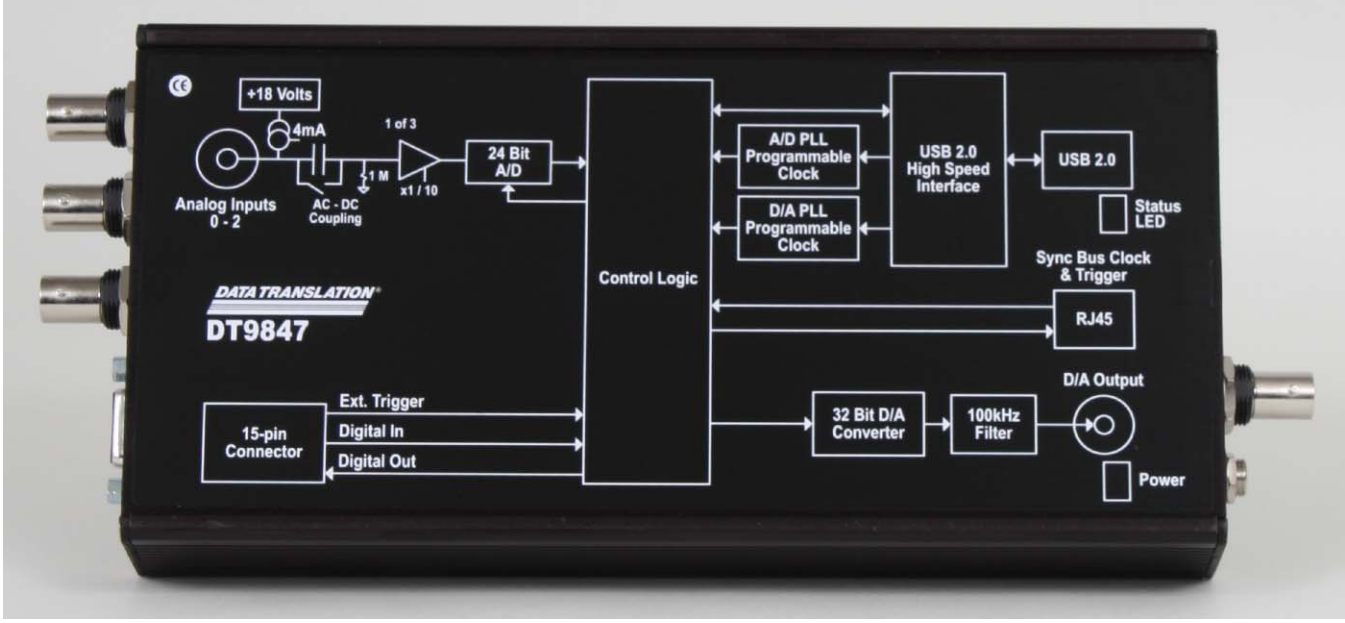

Figure 1: DT9847-3-1 Module

Table 1 lists the major differences between the modules.

Table 1: Major Differences Between the DT9847 Series Modules

Feature	DT9847-1-1	DT9847-2-2	DT9847-3-1
Number of Analog Input Channels	1	2	3
Number of Analog Output Channels	1	2	1
Power	USB Power[a]	External Power[b]	External Power[b]

a. Using USB-Y cable.
b. Using a 5 V to 24 V external power supply at 5 W.

Key Features of the DT9847-1-1

The key features of the DT9847-1-1 module are as follows:

- Simultaneous analog input and waveform analog output operations
- Operates on internal USB power using a USB-Y cable
- Analog input subsystem:
  - One 24-bit A/D converter
  - Throughput rate from 1 kSamples/s to 216 kSamples/s
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source with 18 V compliance voltage for AC or DC coupling
  - Supports a start trigger for acquiring pre-trigger samples and a reference trigger for acquiring post-trigger samples. You can specify the number of post-trigger samples to acquire before stopping the operation.
  - For the start trigger, supports a software-programmable trigger source (software, external digital trigger, or a positive- or negative-going analog threshold trigger. For the threshold trigger, you can program the threshold value from –10 V to +10 V.
  - For the reference trigger, supports a positive- or negative-going analog threshold trigger. You can program the threshold value from –10 V to +10 V.
- Analog output subsystem:
  - One 32-bit D/A converter
  - Single value, waveform, and continuous streaming output
  - Programmable output rate from 30 kSamples/s to 216 kSamples/s
  - Output range of ±3 V
  - Software-programmable trigger source (software trigger or external digital trigger) to start the analog output operation
- Internal clock source (shared between the analog input and analog output subsystems)
- Four digital input lines and 4 digital output lines
- Sync Bus (RJ45) connector for synchronizing acquisition on up to four DT9847 Series modules

Key Features of the DT9847-2-2

The key hardware features of the DT9847-2-2 module are as follows:

- Simultaneous analog input and analog output operations (continuous or waveform mode)
- Operates on external USB power
- Analog input subsystem:
  - Two, simultaneous 24-bit A/D converters
  - Throughput rate from 1 kSamples/s to 216 kSamples/s for simultaneous, high-resolution measurements
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source with 18 V compliance voltage for AC or DC coupling
  - Supports a start trigger for acquiring pre-trigger samples and a reference trigger for acquiring post-trigger samples. You can specify the number of post-trigger samples to acquire before stopping the operation.
  - For the start trigger, supports a software-programmable trigger source (software, external digital trigger, or a positive- or negative-going analog threshold trigger on any of the analog input channels). For the threshold trigger, you can program the threshold value from –10 V to +10 V.
  - For the reference trigger, supports a positive- or negative-going analog threshold trigger on any of the analog input channels. You can program the threshold value from –10 V to +10 V.
- Analog output subsystem:
  - Two 32-bit D/A converters
  - Single value, waveform, and continuous streaming output
  - Programmable output rate from 30 kSamples/s to 216 kSamples/s
  - Output range of ±3 V
  - Software-programmable trigger source (software trigger or external digital trigger) to start the analog output operation
- Internal clock source (shared between the analog input and analog output subsystems)
- Sync Bus (RJ45) connector for synchronizing acquisition on up to four DT9847 Series modules
- Requires use of an external +5 V power supply

Key Features of the DT9847-3-1

The key hardware features of the DT9847-3-1 module are as follows:

- Simultaneous analog input and analog output operations (continuous or waveform mode)
- Operates on external USB power
- Analog input subsystem:
  - Three, simultaneous 24-bit A/D converters
  - Throughput rate from 1 kSamples/s to 216 kSamples/s for simultaneous, high-resolution measurements
  - Input range of ±10 V with software-selectable gains of 1 and 10 for an effective input range of ±10 V and ±1 V
  - Support for IEPE (Integrated Electronic Piezoelectric) inputs, including use of a 4 mA current source with 18 V compliance voltage for AC or DC coupling
  - Supports a start trigger for acquiring pre-trigger samples and a reference trigger for acquiring post-trigger samples. You can specify the number of post-trigger samples to acquire before stopping the operation.
  - For the start trigger, supports a software-programmable trigger source (software, external digital trigger, or a positive- or negative-going analog threshold trigger on any of the analog input channels). For the threshold trigger, you can program the threshold value from –10 V to +10 V.
  - For the reference trigger, supports a positive- or negative-going analog threshold trigger on any of the analog input channels. You can program the threshold value from –10 V to +10 V.
- Analog output subsystem:
  - One 32-bit D/A converter
  - Single value, waveform, and continuous streaming output
  - Programmable output rate from 30 kSamples/s to 216 kSamples/s
  - Output range of ±3 V
  - Software-programmable trigger source (software trigger or external digital trigger) to start the analog output operation
- Internal clock source (shared between the analog input and analog output subsystems)
- Sync Bus (RJ45) connector for synchronizing acquisition on up to four DT9847 Series modules
- Requires use of an external +5 V power supply

Supported Software

The following software is available for use with the DT9847 Series modules and is included on the Data Acquisition OMNI CD:

- **DT9847 Series Device Driver** – The DT9847 Series Device Driver allows you to use a DT9847 Series module with any of the supported software packages or utilities.
- **DT9847 Series Calibration Utility** – This utility, described in Chapter 8 starting on page 101, allows you to calibrate the analog input and analog output circuitry of a DT9847 Series module.
- **VIBpoint Framework application** – This application allows you to acquire and analyze data from up to four synchronized DT9847 Series modules. You can download a 14-day trial version of this application from the Data Translation web site (http://www.datatranslation.com/products/VIBpoint/framework_application.asp). After the trial period has elapsed, you must purchase a license to continue using this application.

Note: The VIBpoint Framework application also supports the DT9837 Series, DT9838, and DT8837 Series devices.

The VIBpoint Framework application lets you perform the following functions:

- Discover and select your modules.
- Configure all input channel settings for the attached sensor, such as the enable state, IEPE settings, input range, tachometer edges, counter edges, and engineering units for the sensor.
- Load/save multiple hardware configurations.
- On each instrument module, acquire data from all channels supported in the input channel list.
- Log acquired data (in the time domain) to disk.
- Display acquired data during acquisition in either a digital display using the Channel Overview window or as a waveform using the Plot Area of the main window.
- Perform single-channel FFT (Fast Fourier Transforms) operations on the acquired analog input data. You can configure a number of parameters for the FFT, including the FFT size, windowing type, averaging type, integration type, and so on.
- Choose from a large number of two-channel FFT options, including: Frequency Response Functions (Inertance, Mobility, Compliance, Apparent Mass, Impedance, Dynamic Stiffness, or custom FRF) with H1, H2, or H3 estimator types, Cross-Spectrum, Power Spectral Density, Coherence, and Coherent Output Power.
- Display time domain data as it is acquired and/or after applying windowing functions.
- Display frequency domain data as Amplitude, Phase, or Nyquist.
- Configure and view statistics about the FFT data, including the frequency and value of the highest peaks.

  - Open recorded data in Excel for further analysis.
  - Customize many aspects of the acquisition, display, and recording functions to suit your needs, including the clock frequency and the trigger settings.

  You can use the VIBpoint Framework application in one of two modes: Acquisition mode, which allows you to acquire data, or File Reader mode, which allows you to view a previously recorded data file. Refer the documentation for the VIBpoint Framework application for detailed information about the application.

- **Quick DataAcq application** – The Quick DataAcq application provides a quick way to get up and running using a DT9847 Series module. Using this application, you can verify key features of the modules, display data on the screen, and save data to disk. (Note that this application does not support configuring AC/DC coupling or the excitation current source for IEPE inputs.)
- **The quickDAQ application –** An evaluation version of this .NET application is included on the Data Acquisition OMNI CD. quickDAQ lets you acquire analog data from all devices supported by DT-Open Layers for .NET software at high speed, plot it during acquisition, analyze it, and/or save it to disk for later analysis.
- **DT-Open Layers for .NET Class Library** – Use this class library if you want to use Visual C# or Visual Basic for .NET to develop your own application software for a DT9847 Series module using Visual Studio 2003 or Visual Studio 2005; the class library complies with the DT-Open Layers standard.
- **DataAcq SDK** – Use the Data Acq SDK if you want to use Visual Studio 6.0 and Microsoft C or C++ to develop your own application software for a DT9847 Series module using Windows XP, Windows Vista, Windows 7, or Windows 8; the DataAcq SDK complies with the DT-Open Layers standard.
- **DAQ Adaptor for MATLAB** – Data Translation's DAQ Adaptor provides an interface between the MATLAB Data Acquisition (DAQ) subsystem from The MathWorks and Data Translation's DT-Open Layers architecture.
- **LV-Link** – An evaluation version of LV-Link is included on the Data Acquisition OMNI CD. Use LV-Link if you want to use the LabVIEW graphical programming language to access the capabilities of the DT9847 Series module.

Refer to the Data Translation web site (www.datatranslation.com) for information about selecting the right software package for your needs.

Supported Accessories

The following accessories are available for the DT9847 Series:

- **EP386 panel** – The EP388 panel, shown in Figure 2, contains four RJ45 connectors that are wired in parallel, making it useful when attaching up to four DT9847 Series modules together using the Sync Bus connector. Refer to page 78 for more information on using this panel.

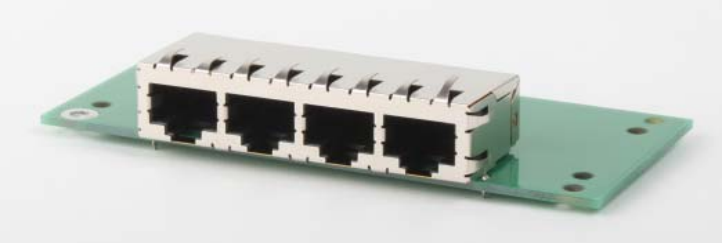

Figure 2: EP386 Panel

- **BNC DIN Rail Kit** – The BNC DIN Rail Kit, shown in Figure 3, allows you to mount USB modules that are packaged in metal boxes in a DIN rail. The kit includes mounting clips, screws, and instructions. The rail is not included.

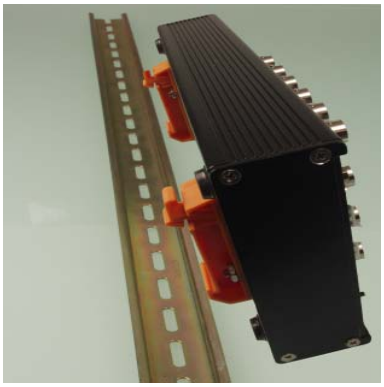

Figure 3: BNC DIN Rail Kit

Getting Started Procedure

The flow diagram shown in Figure 4 illustrates the steps needed to get started using a DT9847 Series module. This diagram is repeated in each Getting Started chapter; the shaded area in the diagram shows you where you are in the getting started procedure.

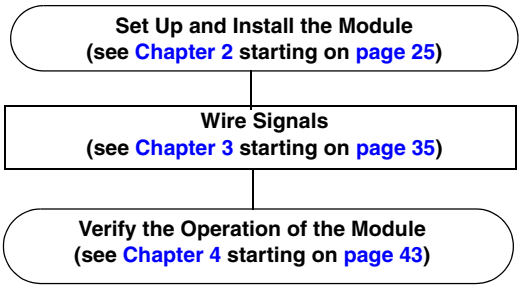
Set Up and Install the Module
(see Chapter 2 starting on page 25)
Wire Signals
(see Chapter 3 starting on page 35)
Verify the Operation of the Module
(see Chapter 4 starting on page 43)

Figure 4: Getting Started Flow Diagram

Part 1: Getting Started

Setting Up and Installing the Module

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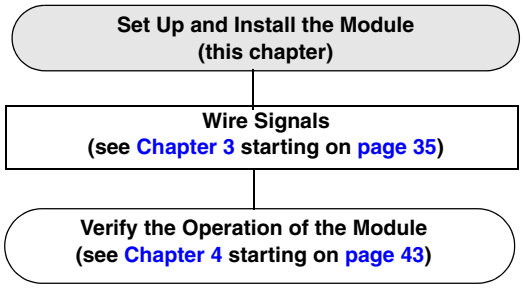

Set Up and Install the Module
(this chapter)
Wire Signals
(see Chapter 3 starting on page 35)
Verify the Operation of the Module
(see Chapter 4 starting on page 43)

Unpacking

Open the shipping box and verify that the following items are present:

- DT9847-1-1, DT9847-1-1-OEM, DT9847-2-2, DT9847-2-2-OEM, DT9847-3-1, or DT9847-3-1-OEM module
- Data Acquisition OMNI CD-ROM
- If you ordered a DT9847-1-1 or DT98471-1-OEM module, the EP399 USB-Y cable is included. Optionally, you can use a +5 V external power supply (not included) to power the DT9847-1-1-OEM module.

CAUTION:

Ensure that the maximum voltage of the external supply is +5 V ±0.30 V. @ 600 mA. Higher voltages will destroy the DT9847-1-1-OEM module.

- If you ordered a DT9847-2-2 or DT9847-3-1 module, the EP365 USB cable and EP394 +5 V external power supply are included.
- If you ordered a DT9847-2-2-OEM or DT9847-3-1-OEM module, the EP365 USB cable is included. To power the module, you must use a 5 V to 24 V external power supply (not included).

If an item is missing or damaged, contact Data Translation. If you are in the United States, call the Customer Service Department at (508) 481-3700, ext. 1323. An application engineer will guide you through the appropriate steps for replacing missing or damaged items. If you are located outside the United States, call your local distributor, listed on Data Translation's web site (www.datatranslation.com).

Note: The DT9847 Series modules are factory-calibrated. If you decide that you want to recalibrate the analog input or analog output circuitry, refer to the instructions in Chapter 8.

Applying Power to the Module

The DT9847-1-1 module runs on USB power and does not use an external power supply. The DT9847-2-2 and DT9847-3-1 modules require an external power supply and come with an EP394 +5V power supply and cable.

Note: If you are using the OEM version of a DT9847 Series module, refer to Appendix C starting on page 125 for information on powering the module.

To apply power to the module, do the following:

1. Connect the EP394 +5 V power supply to the external power connector on the DT9847 Series module. Refer to Figure 5.

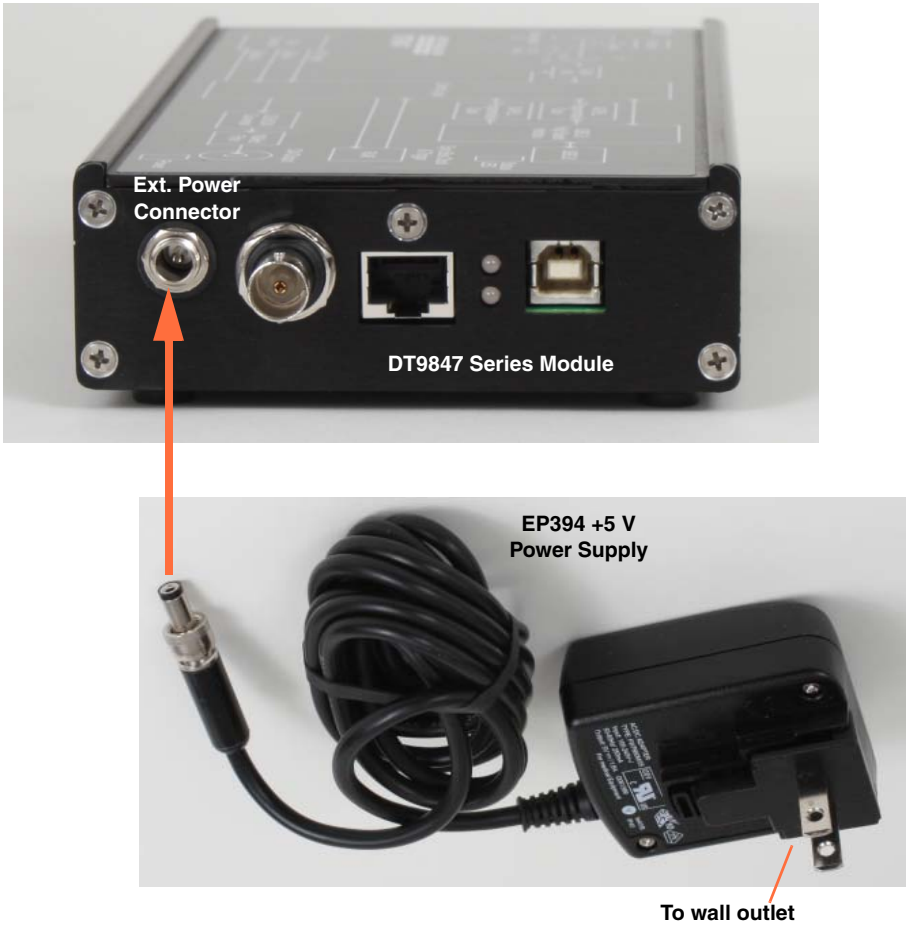


Figure 5: Attaching a +5 V Power Supply to the DT9847 Series Module

2. Plug the power supply into a wall outlet.

Attaching Modules to the Computer

This section describes how to attach a DT9847 Series module to the host computer.

Note: Most computers have several USB ports that allow direct connection to USB devices. If your application requires more DT9847 Series modules than you have USB ports for, you can expand the number of USB devices attached to a single USB port by using expansion hubs. For more information, refer to page 31.

You can unplug a module, then plug it in again, if you wish, without causing damage. This process is called hot-swapping. Your application may take a few seconds to recognize a module once it is plugged back in.

The DT9847 Series modules use less than 500 mA; therefore, they do not require an external power supply.

You must install the device driver for your module before connecting the module(s) to the host computer. Run the installation program on your Data Acquisition OMNI CD to install the device driver and other software for the module.

Connecting Directly to the USB Ports

To connect a DT9847 Series module directly to a USB port on your computer, perform the following steps:

1. Attach one end of the USB cable to the USB port on the module and the other end to the USB port on your host computer.

   If you are using the DT9847-1-1, use the EP399 USB-Y cable to connect the module to two USB ports on the host computer, as shown in Figure 6.

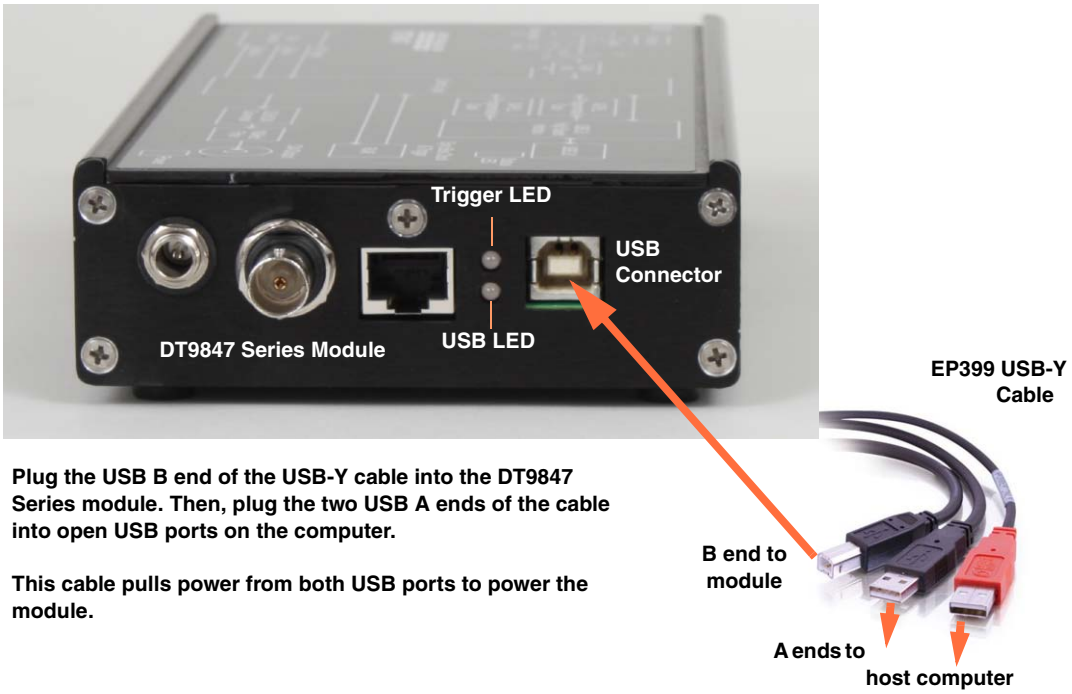

Trigger LED
USB
Connector
DT9847 Series Module
USB LED
EP399 USB-Y
Cable
Plug the USB B end of the USB-Y cable into the DT9847 Series module. Then, plug the two USB A ends of the cable into open USB ports on the computer.
This cable pulls power from both USB ports to power the module.
B end to
module
A ends to
host computer

Figure 6: Attaching the DT9847-1-1 Module to the Host Computer

Once the module is connected to the host computer, the operating system automatically detects the USB module and starts the Found New Hardware wizard.

2. *For Windows Vista*:

   a. Click **Locate and install driver software (recommended)**.
   The popup message "Windows needs your permission to continue" appears.

   b. Click **Continue**.
   The Windows Security dialog box appears.

   c. Click **Install this driver software anyway**.

   For Windows XP:

   a. Click **Next** and/or **Finish** as required in the wizard.
   Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.

   b. Click **Next** and/or **Finish** again.

Note: Windows 7 and Windows 8 find the device automatically.

3. Repeat these steps to attach another DT9847 Series module to the host computer, if desired.

Note: Once you have connected your module to the host computer, power is turned on to the module when your application program opens the module. The USB LED on the module turns green to indicate that power is turned on.

Power is turned off to the module when your application program terminates its connection to the module.

Connecting to an Expansion Hub

Expansion hubs are powered by their own external power supply. The practical number of DT9847 Series modules that you can connect to a single USB port depends on the throughput you want to achieve.

To connect multiple DT9847 Series modules to an expansion hub, do the following:

1. Attach one end of the USB cable to the module and the other end of the USB cable to an expansion hub.

   If you are using the DT9847-1-1, use the EP399 USB-Y cable to connect the module to two USB ports on the expansion hub, as shown in Figure 7.

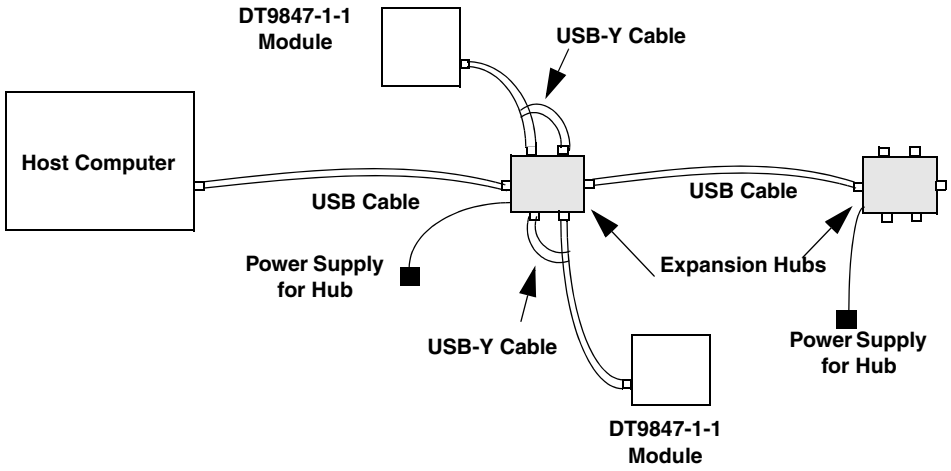


Figure 7: Attaching Multiple DT9847-1-1 Modules Using Expansion Hubs

2. Connect the power supply for the expansion hub to an external power supply.
3. Connect the expansion hub to the USB port on the host computer using another USB cable. Figure 8 shows how to attach DT9847-2-2 and DT9847-3-1 modules to an expansion hub.
   The operating system automatically detects the USB module and starts the Found New Hardware wizard.

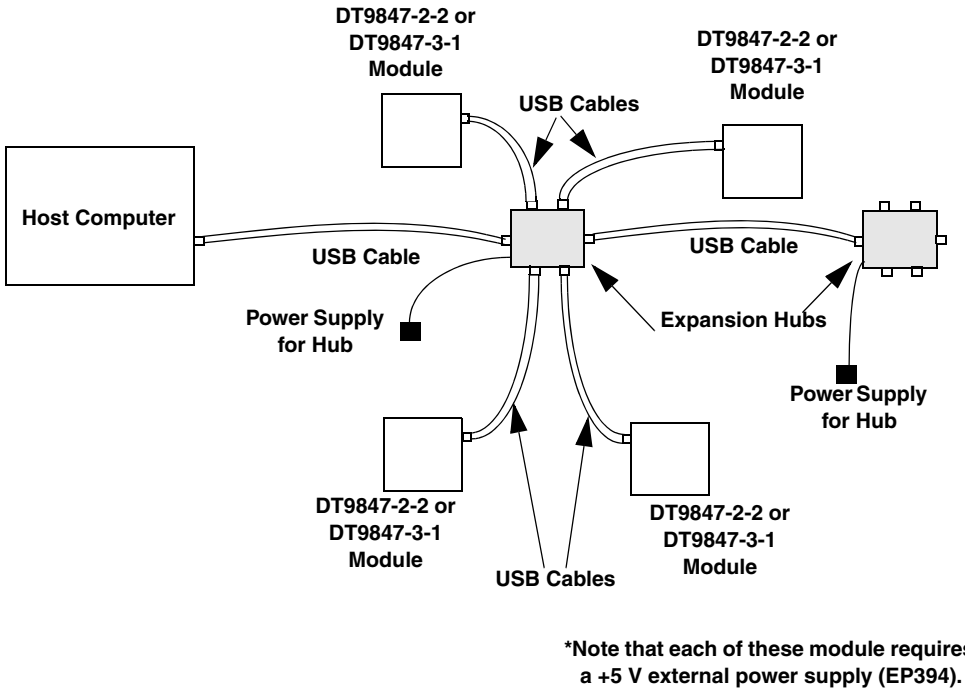


Figure 8: Attaching Multiple DT9847-2-2 and DT9847-3-1 Modules Using Expansion Hubs

4. *For Windows Vista:*

   a. Click **Locate and install driver software (recommended)**.
   The popup message "Windows needs your permission to continue" appears.

   b. Click **Continue**.
   The Windows Security dialog box appears.

   c. Click **Install this driver software anyway**.

   For Windows XP:

   a. Click **Next** and/or **Finish** as required in the wizard.
   Once the firmware is loaded, the wizard restarts to initiate the firmware to accept commands.

   b. Click **Next** and/or **Finish** again.

Note: Windows 7 and Windows 8 find the device automatically.

5. Repeat these steps until you have attached the number of expansion hubs and modules that you require.
   The operating system automatically detects the USB devices as they are installed.

Note: Once you have connected your module to the host computer, power is turned on to the module when your application program opens a connection to the module. The LED on the module turns green to indicate that power is turned on.

Power is turned off to the module when your application program terminates its connection to the module.

Configuring the DT9847 Series Device Driver

Note: In Windows 7, Windows 8, and Windows Vista, you must have administrator privileges to run the Open Layers Control Panel. When you double-click the Open Layers Control Panel icon, you may see the Program Compatibility Assistant. If you do, select **Open the control panel using recommended settings**. You may also see a Windows message asking you if you want to run the Open Layers Control Panel as a "legacy CPL elevated." If you get this message, click **Yes**.

If you do not get this message and have trouble making changes in the Open Layers Control Panel, right click the DTOLCPL.CPL file and select **Run as administrator**. By default, this file is installed in the following location:

Windows 7, Windows 8, and Vista (32-bit)
C:\Windows\System32\Dtolcpl.cpl

Windows 7, Windows 8, and Vista (64-bit)
C:\Windows\SysWOW64\Dtolcpl.cpl

To configure the device driver for a DT9847 Series module, do the following:

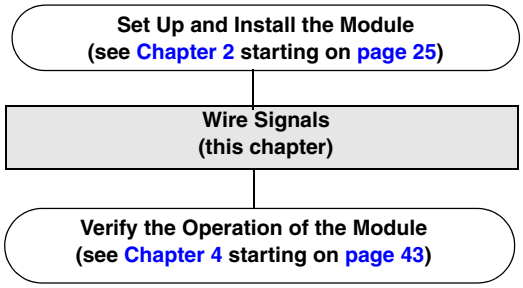
1. If you have not already done so, power up the host computer and all peripherals.
2. From the Windows Start menu, select **Settings | Control Panel**.
3. From the Control Panel, double-click **Open Layers Control Panel**.
   The Data Acquisition Control Panel dialog box appears.
4. If you want to rename the module, click the name of the module that you want to rename, click **Edit Name**, enter a new name for the module, and then click **OK**. The name is used to identify the module in all subsequent applications.
5. Select the module that you want to configure, and then click **Advanced**.
   The Measurement Options dialog box appears.
6. For the Coupling type, select **AC** for AC coupling or **DC** for DC coupling for each analog input channel.
7. For the Current Source, select **Enabled** to enable the internal excitation current source or **Disabled** to disable the internal excitation current source for each analog input channel.

   Note: If you enable the use of the internal excitation current source, it is recommended that you choose AC coupling. Refer to page 38 for more information on wiring IEPE inputs.

8. When you are finished, click **OK** to close the Measurement Options dialog box.
9. Repeat steps 4 to 8 for the other modules that you want to configure.
10. When you are finished configuring the modules, click **Close** to close the Control Panel.

Wiring Signals

Preparing to Wire Signals 37
Connecting Analog Input Signals 38
Connecting an Analog Output Signal 39
Connecting Digital I/O Signals 41


Set Up and Install the Module
(see Chapter 2 starting on page 25)
Wire Signals
(this chapter)
Verify the Operation of the Module
(see Chapter 4 starting on page 43)

Preparing to Wire Signals

This section provides recommendations and information about wiring signals to a DT9847 Series module.

Wiring Recommendations

Keep the following recommendations in mind when wiring signals to a DT9847 Series module:

- Follow standard ESD procedures when wiring signals to the module.
- Separate power and signal lines by using physically different wiring paths or conduits.
- To avoid noise, do not locate the module and cabling next to sources that produce high electromagnetic fields, such as large electric motors, power lines, solenoids, and electric arcs, unless the signals are enclosed in a mumetal shield.
- Prevent electrostatic discharge to the I/O while the module is operational.
- Connect all unused analog input channels to analog ground.

Wiring Signals to the Module

Figure 9 shows the connectors on the DT9847-3-1 module. Note that the DT9847 has only one analog input connector and one analog output connector, while the DT9847-2-2 has two analog input connectors and two analog output connectors, and the DT9847-3-1 has three analog input connectors and one analog output connector.

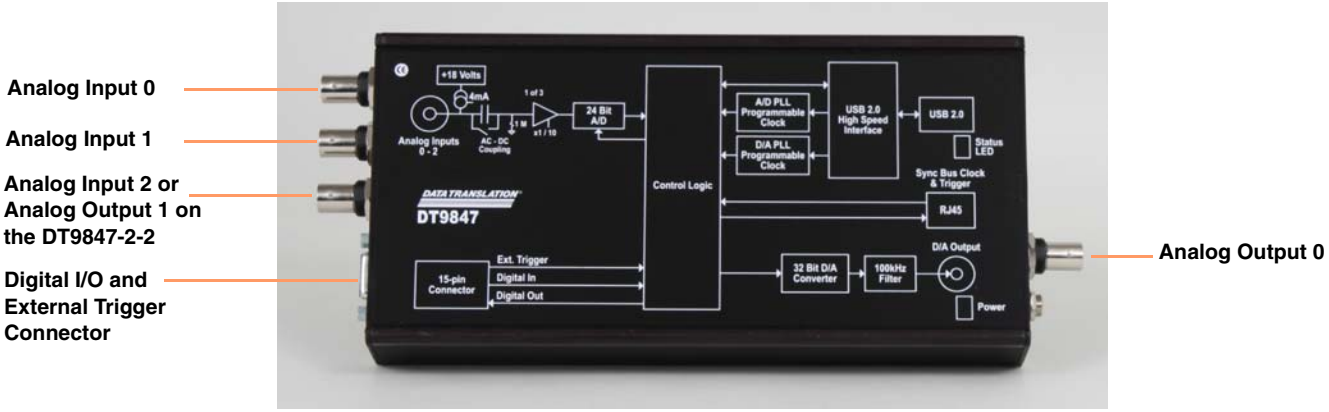


Figure 9: Connectors on the DT9847 Series Module

The remaining sections of this chapter describe how to attach signals to these connectors.

Connecting Analog Input Signals

For the DT9847-1-1 module, you can connect one analog input signal (or IEPE sensor) to the BNC connector on the module. For the DT9847-2-2 module, you can connect up to two analog input signals (or IEPE sensors) to the BNC connectors on the module. For the DT9847-3-1 module, you can connect up to three analog input signals (or IEPE sensors) to the BNC connectors on the module. Internally, these signals are connected in single-ended mode. The DT9847 Series modules support an input signal range of ±10 V (using a gain of 1) or ±1 V (using a gain of 10).

Note: If you enable the use of the internal excitation current source for IEPE inputs, it is recommended that you choose AC coupling. Refer to page 62 for more information on IEPE inputs.

Figure 10 shows how to connect an analog input signal (channel 0, in this case) to a BNC connector on the DT9847 Series module.

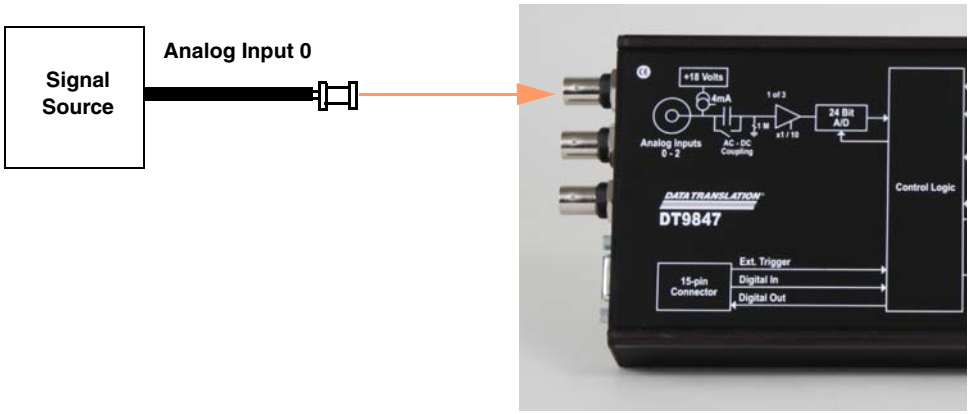


Figure 10: Connecting Analog Inputs to a DT9847 Series Module

Connecting an Analog Output Signal

The DT9847-1-1 and DT9847-3-1 modules provide one analog output channel. The DT9847-2-2 modules provides two analog input channels. The output channels have an output range of ±3 V.

Figure 11 shows how to connect an analog output signal to the DT9847-1-1 or DT9847-3-1 module.

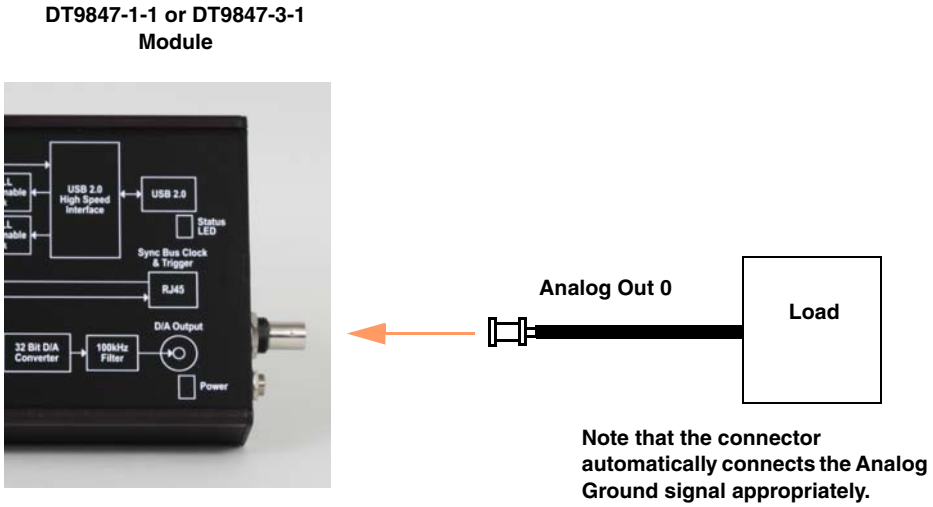


Figure 11: Connecting an Analog Output Signal to the DT9847-1-1 or DT98473-1 Module

Figure 12 shows how to connect analog output signals to the DT9847-2-1 module.

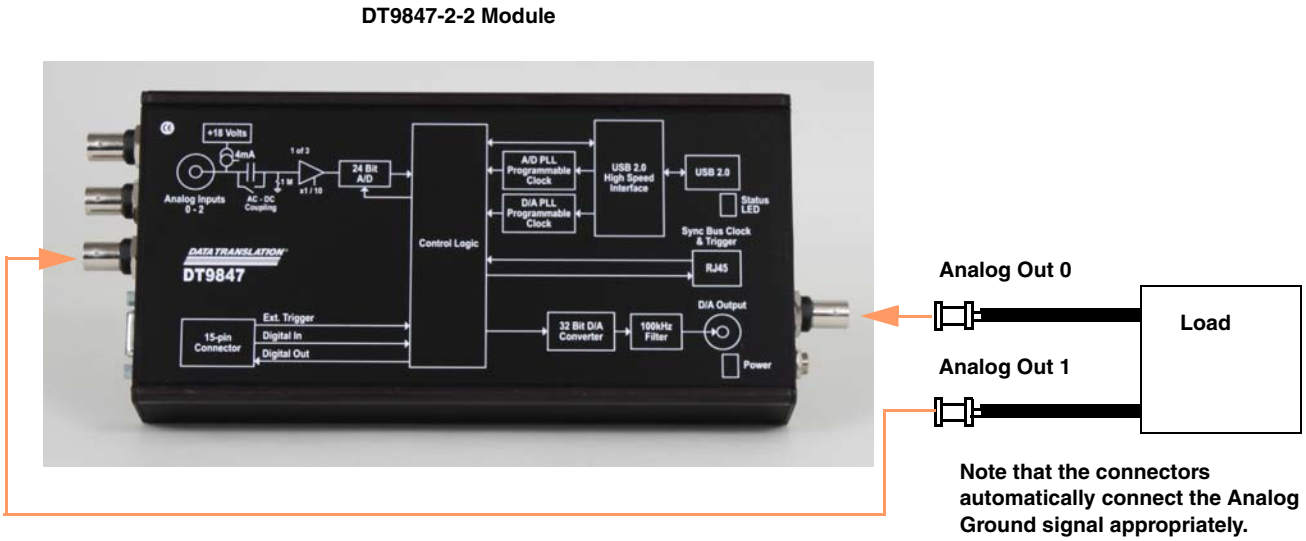


Figure 12: Connecting Analog Output Signals to the DT9847-2-2 Module

Connecting Digital I/O Signals

Figure 13 shows the layout of the 15-pin Digital I/O and External Trigger connector on the DT9847 Series modules.

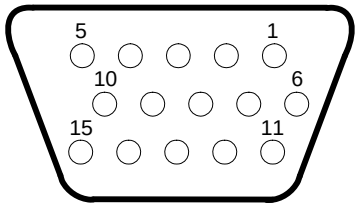


Figure 13: Layout of the Digital I/O and External Trigger Connector

Figure 14 shows how to connect digital input signals (lines 0 and 1, in this case) to the pins of the Digital I/O and External Trigger connector.

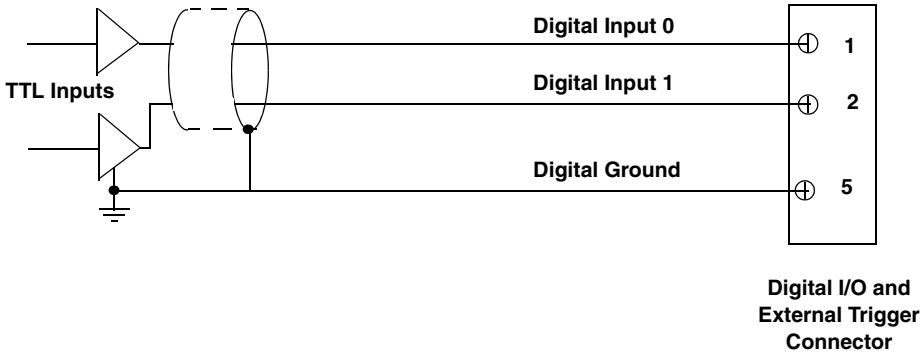


Figure 14: Connecting Digital Inputs to the Digital I/O and External Trigger Connector

Figure 15 shows how to connect a digital output (line 0, in this case) to the pins of the Digital I/O and External Trigger connector.

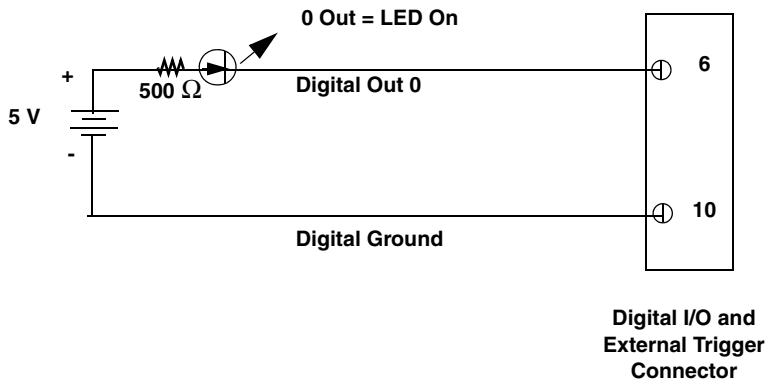
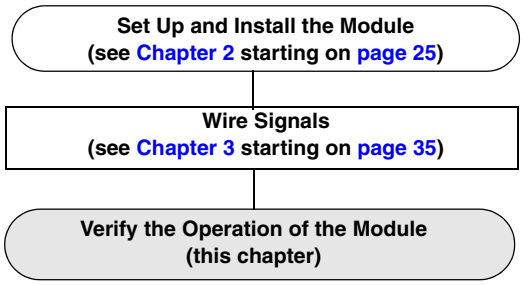


Figure 15: Connecting Digital Outputs to the Digital I/O and External Trigger Connector

Verifying the Operation of a Module

Selecting the Device 45
Example of Monitoring the Analog Output Signal 48


Set Up and Install the Module
(see Chapter 2 starting on page 25)
Wire Signals
(see Chapter 3 starting on page 35)
Verify the Operation of the Module
(this chapter)

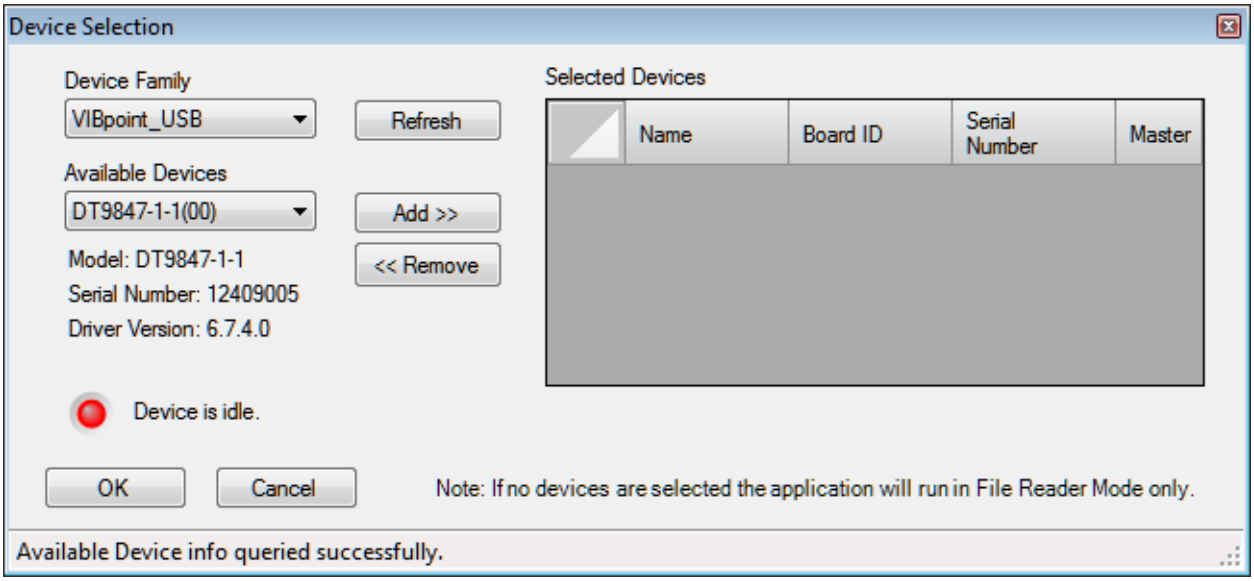
You can verify the operation of a DT9847 Series module using the VIBpoint Framework application. You can download a 14-day trial version of this application from the Data Translation web site (http://www.datatranslation.com/products/VIBpoint/framework_application.asp). After the trial period has elapsed, you must purchase a license to continue using this application.

Note: The VIBpoint Framework application also supports other devices, including the DT9837 Series, DT9838, and DT8837 Series.

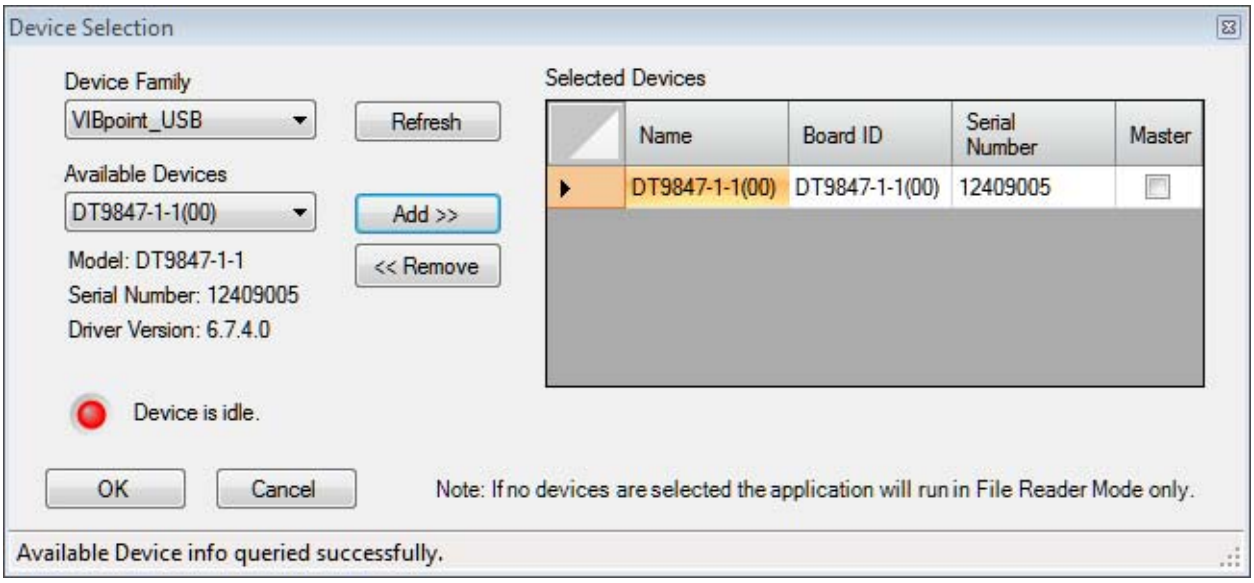
Selecting the Device

To get started with your DT9847 Series module and the VIBpoint Framework application, follow these steps:

1. Connect the DT9847 Series module to the USB port of your computer, and connect your sensors to the module.
2. Start the VIBpoint Framework application.
   The Device Selection window appears.



3. For the Device Family selection, select **VIBpoint_USB**.
   By default, the application "discovers" all devices that are available for the specified device family and displays the module name for the USB devices in the drop-down list. If you want to refresh this list to determine if other devices are available, click **Refresh**.
4. Select the module name for the DT9847 Series module that you want to use from the list of Available Devices, and click **Add**.
   Information about the device, including the model number, serial number, firmware version, driver version, and scanning status is displayed.



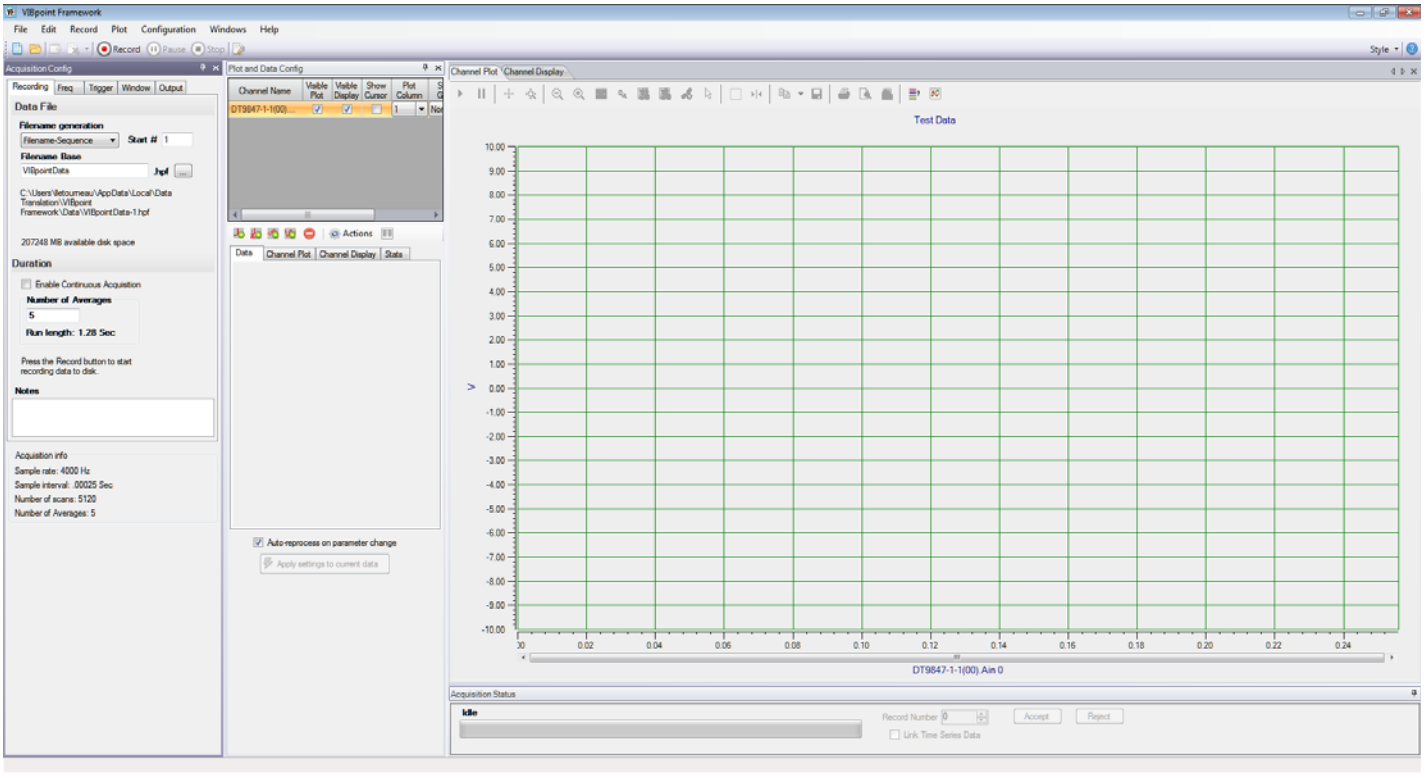
5. If you want to rename your device, do the following:
   a. Click the Row Selector button for the device.
   b. Click the IP address or module name in the **Name** column to highlight it and enter a meaningful name to represent each available device.
6. If you are using multiple devices, you must configure one device as the clock and trigger master, as follows:
   a. Click the Row Selector button for the device that you want to be the clock and trigger master.
   b. For the clock and trigger master device, check the box under the **Master** column.

Note: Only one device can be the clock and trigger master. If you are using a single device, the application automatically configures the device as the master.

DT9847 Series modules support that capability of synchronizing up to four devices. If you are using more than one of these devices, ensure that you connect the devices together using network cables and the Sync Bus (RJ45) connector on each device. Then, configure one device as the master and the other devices as slaves. The software automatically drives out the appropriate clock and trigger signals. Refer to page 78 for more information on synchronizing devices.

---

7. (Optional) If you want to remove a device from list of selected devices, click the Row Selector button for the device, and then click **Remove**.
8. Once you have added all the devices that you want to use with the application, click **OK**. *The latest state is saved and used when the application is next run, and the interface of the VIBpoint Framework application is displayed.*


VIBpoint Framework
File Edit Record Plot Configuration Windows Help
Record Pause Stop
Style
Acquisition Config
Recording Freq Trigger Window Output
Data File
Filename generation
Filename-Sequence
Start # 1
Filename Base
VIBpointData
.hpf
C:\Users\Vetourneau\AppData\Local\Data Translation\VIBpoint Framework\Data\VIBpointData-1.hpf
207248 MB available disk space
Duration
Enable Continuous Acquisition
Number of Averages
5
Run length: 1.28 Sec
Press the Record button to start recording data to disk.
Notes
Acquisition info
Sample rate: 4000 Hz
Sample interval: .00025 Sec
Number of scans: 5120
Number of Averages: 5
Plot and Data Config
Channel Name
Visible Plot
Visible Display
Show Cursor
Plot Column
DT9847-1-1(00)...
Actions
Data
Channel Plot
Channel Display
Stats
Auto-reprocess on parameter change
Apply settings to current data
Channel Plot
Channel Display
Test Data
V
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
-1.00
-2.00
-3.00
-4.00
-5.00
-6.00
-7.00
-8.00
-9.00
-10.00
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.20
0.22
0.24
DT9847-1-1(00),Ain 0
Acquisition Status
Idle
Record Number
Accept
Reject
Link Time Series Data

Example of Monitoring the Analog Output Signal

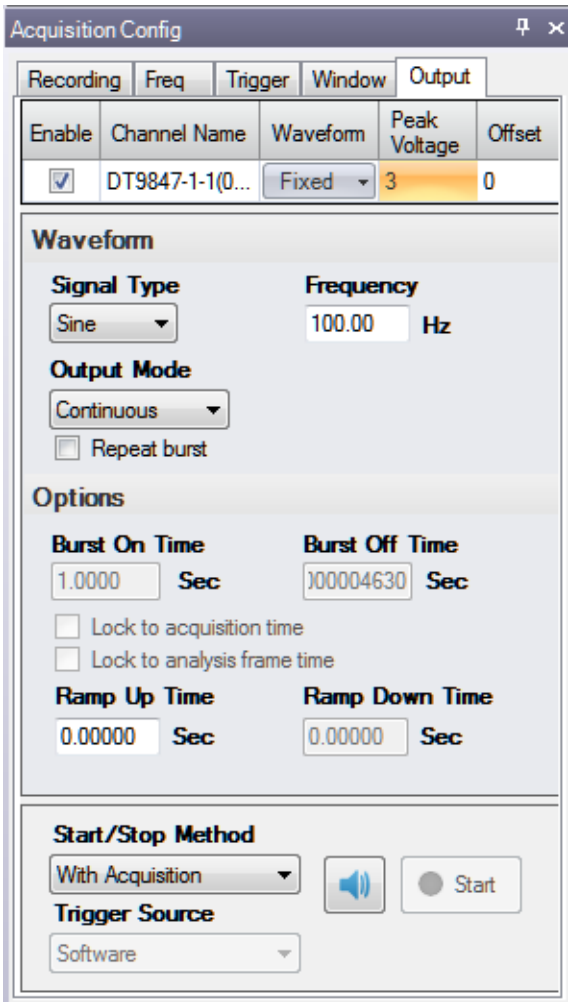
The following steps describe how to use the VIBpoint Framework application to monitor the output of the analog output signal using an analog input channel.

In this example, a 3 V sine wave is output on analog output channel 0 of a DT9847-1-1 module. The analog output channel is connected to analog input channel 0 on the DT9847-1-1 module.

Configure the Analog Output Settings

For this example, configure the analog output channel as follows:

1. Click the **Output** tab of the Acquisition and Config window.



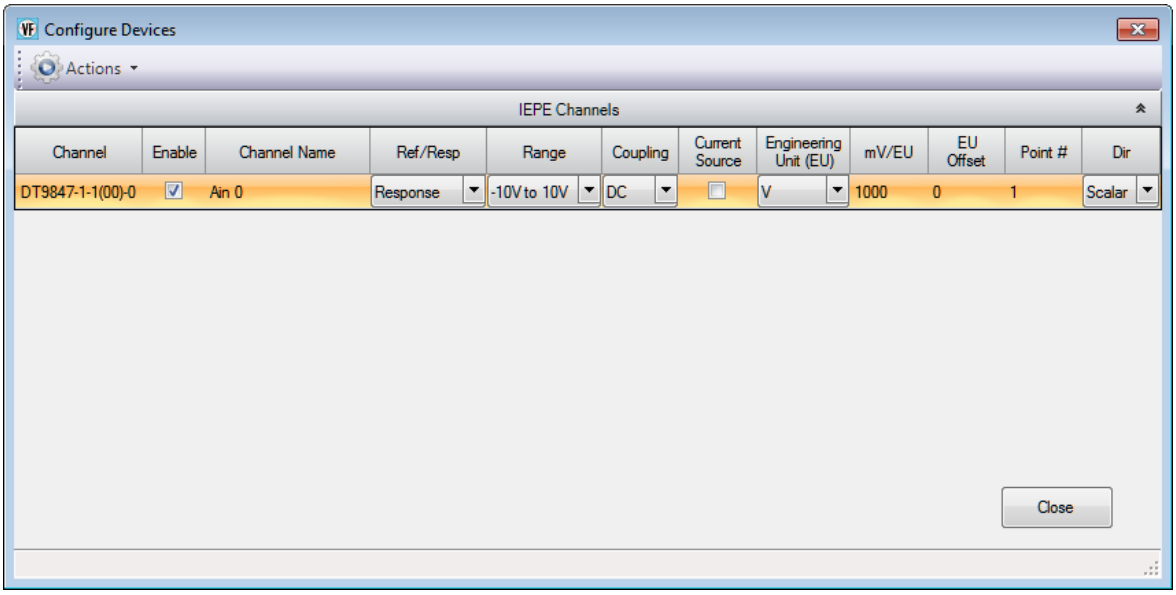
2. Select the **Enable** checkbox to enable the analog output channel on the module.
3. For the **Waveform** type, select **Fixed**.
4. For **Peak Voltage,** enter **3** to output a ±3 V signal.
5. For **Offset**, enter **0**.

6. For **Signal Type**, select **Sine** to output a sine wave.
7. For **Output Mode**, select **Continuous** to output a waveform that repeats continuously.
8. For **Frequency**, select **100 Hz**; this is the frequency of the output waveform.
9. For **Ramp Up Time**, enter **0**.
10. For the **Start/Stop Method**, select **With Acquisition**.
    The analog output operation will start when you start acquisition.
11. If desired, hide the Acquisition Config window by clicking the Auto-Hide pin ( ) in the top, right corner of the window.

Configure the Analog Input Channel

Configure the analog input channel as follows:

1. Ensure that the output from analog output channel 0 is connected to the input of analog input channel 0.
2. Configure the analog input channel by clicking the **Input Channel Configuration** toolbar button ( ) or by clicking the **Configuration** menu and clicking **Input Channel Configuration**.
3. Enable analog input channel 0 by clicking the **Enable** checkbox next to the channel.



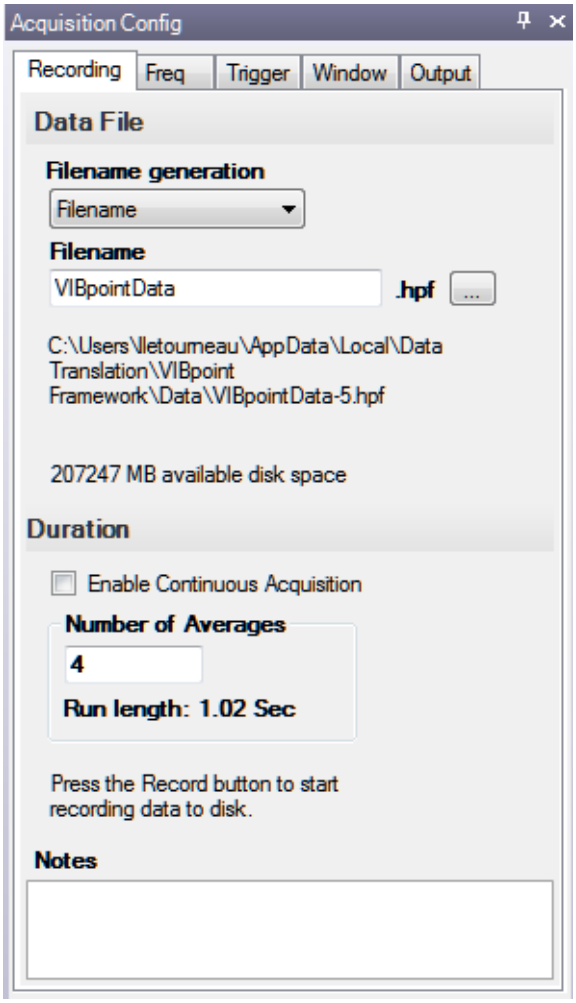
4. Under the **Channel Name** column, leave the default channel name as Ain 0.
5. Under the **Ref/Resp** column, select **Response** for the analog input channe1.
6. Under the **Range** column, select the input range for analog input channel.
   *In this example, **±10 V** is used.*
7. Under the **Coupling** column, select the coupling type (AC or DC) for your sensor.
   *Since this example is monitoring a voltage input, **DC** is used.*

8. Under the **Current Source** column, select whether to enable or disable use of the 4 mA current source on the data acquisition device.
   *Since this example is monitoring a voltage input, the **Current Source** checkbox is not checked (disabled) for the analog input channel.*
9. Under the **Engineering Units** column, select the engineering units for the input.
   *In this example, **V** is used.*
10. Enter the number of mV per engineering unit in the **mV/EU** field.
    *In this example, **1000** is used.*
11. If an offset is specified for the input, enter the value in the **EU Offset** field.
    *In this example, no offset (**0**) is specified.*
12. If desired, enter a test point value for the channel.
    *In this example, **0** is used.*
13. If desired, enter a sensor direction for each channel.
    *In this example, **Scalar** is used.*
14. Click **Close** to close the Configure Devices dialog box.

Configure the Recording Settings

For this example, configure the recording settings as follows:

1. Click the **Recording** tab of the Acquisition Config window.

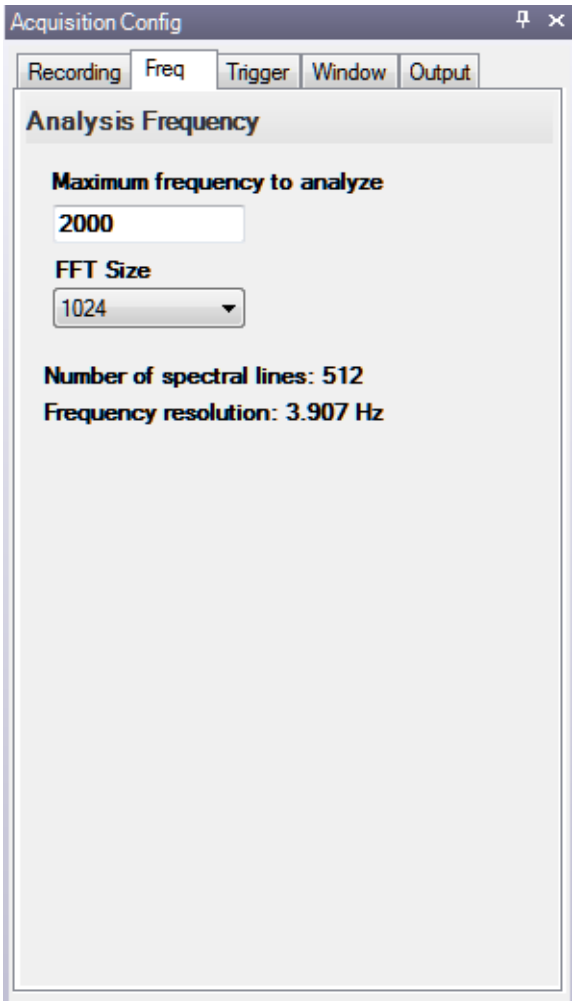


2. For **Filename generation**, use the default **Filename** option.
3. For **Filename**, use the default name for the data file.
4. Leave the **Enable Continuous Acquisition** checkbox unchecked.
5. For **Number of Averages**, enter **4** as the number of records to acquired, process, and average before acquisition stops.
   The number of seconds for the total run and the amount of available disk space are shown.

Configure the Frequency Settings

For this example, configure the frequency settings as follows:

1. Click the **Freq** tab of the Acquisition Config window.

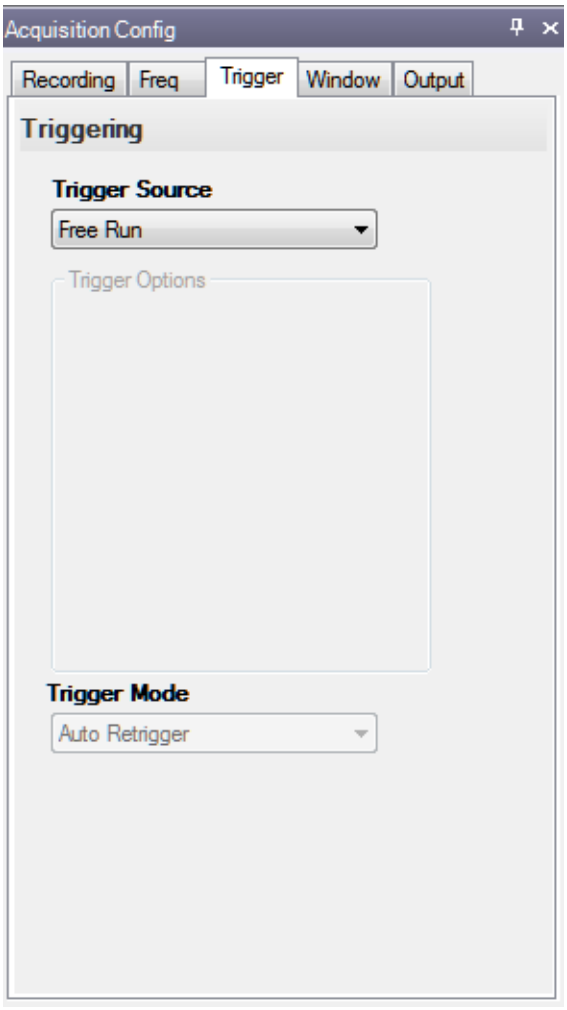


2. In the **Maximum frequency to analyze** text box, enter **2000** as the bandwidth or span, in Hz, of the input signals that you want to analyze
   Internally, the sampling rate of the data acquisition device is set to twice the bandwidth, or 4000 Hz in this example.
3. In the **FFT Size** text box, select **1024** from the drop-down combo box as the number of data points to use for the FFT calculation.
   The number of spectral lines and the frequency resolution are displayed.

Configure the Trigger Settings

For this example, configure the trigger settings as follows:

1. Click the **Trigger** tab of the Acquisition Config window.

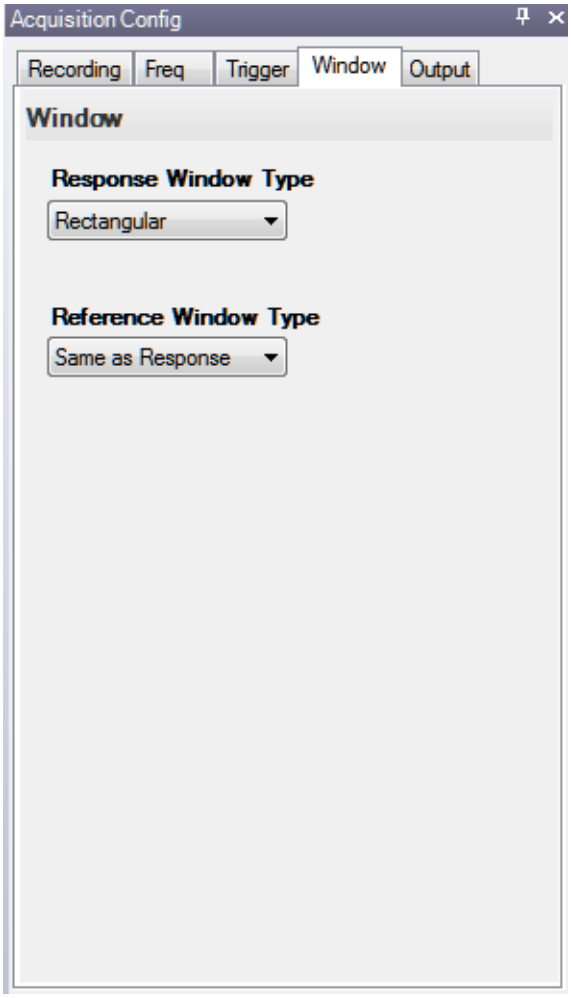


2. For the **Trigger Source**, select **Free Run** to ensure that the measurement starts as soon as the **Record** button is clicked.

Configure the Windowing Function

For this example, configure the windowing function as follows:

1. Click the **Window** tab of the Acquisition and Config window.

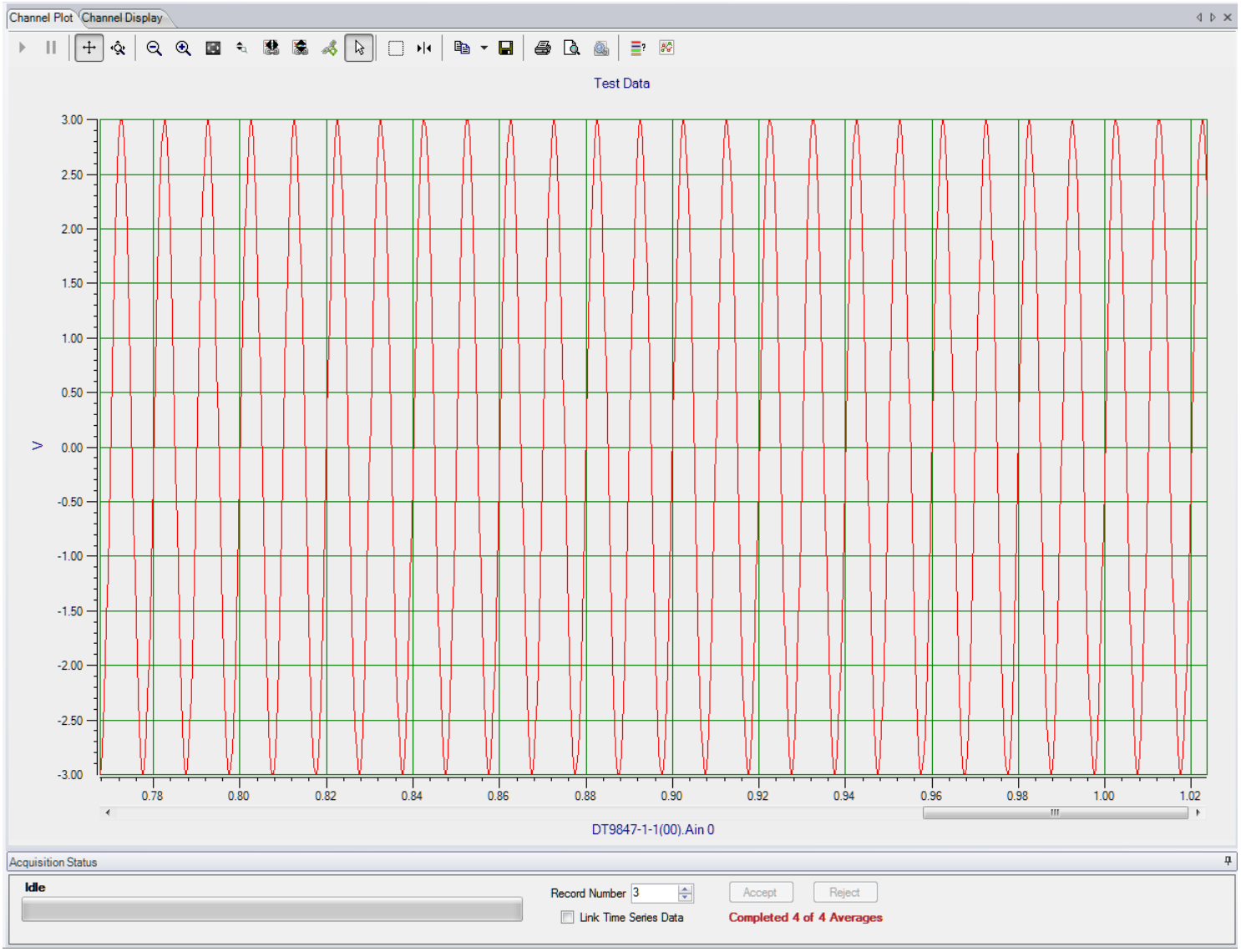


2. For the **Response Window Type**, select **Rectangular**.
   This is a global setting that is applied to the FFTs for all enabled analog input channels that are configured as response channels.
3. For the **Reference Window Type**, leave the setting as **Same As Response**.
   This example does not use reference channels.
4. If desired, hide the Acquisition Config window by clicking the Auto-Hide pin ( ) in the top, right corner of the window.

Start the Operation

Once you have configured the channels and the application parameters, click the **Record** toolbar button (Record) or press the **F5** key to start the operation.

Results similar to the following are displayed in the Channel Plot window, showing the output of analog output channel 0 as measured by analog input channel 0.



Note: Many additional options are provided in VIBpoint Framework for measuring and analyzing the data. Refer to the *VIBpoint Framework Application User's Manual* for detailed information.

Part 2: Using Your Module

Principles of Operation

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Triggering Acquisition on Multiple Modules 77
Synchronizing Acquisition on Multiple DT9847 Series Modules 78

Figure 16 shows a block diagram of the DT9847-1-1 module.

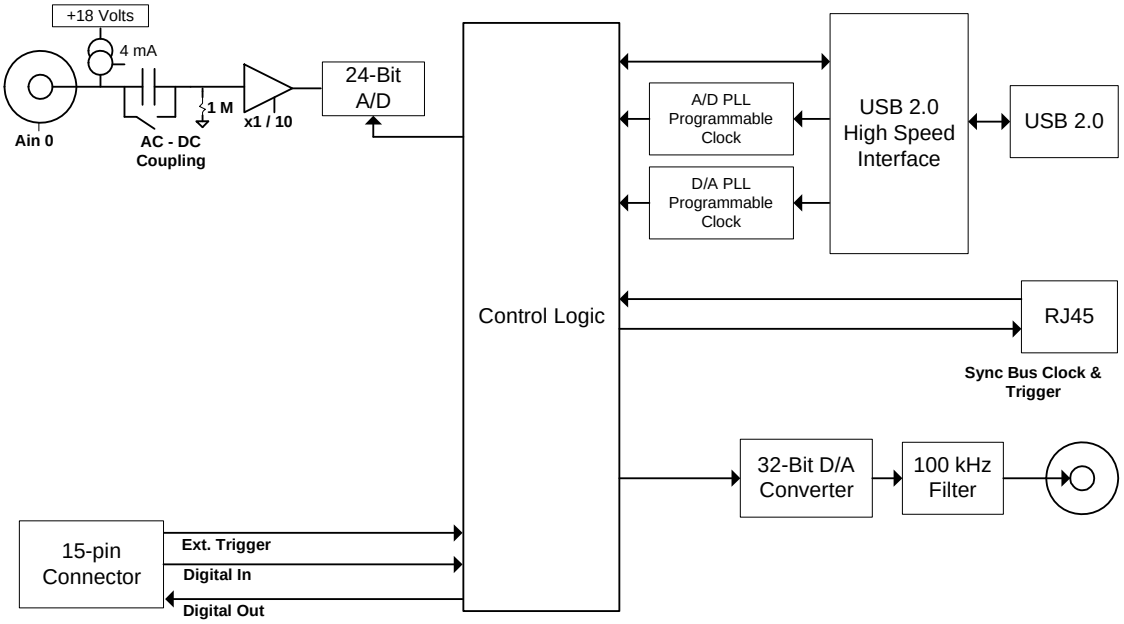

Figure 16: Block Diagram of the DT9847-1-1 Module

Figure 17 shows a block diagram of a DT9847-2-2 module.

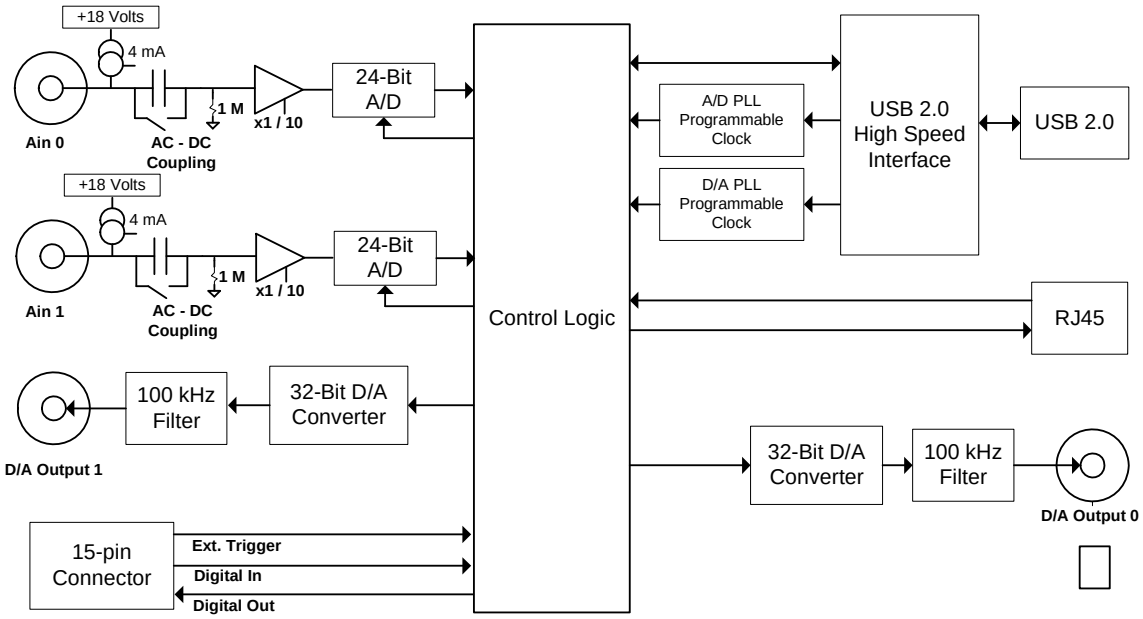

Figure 17: Block Diagram of the DT9847-2-2 Module

Figure 18 shows a block diagram of the DT9847-3-1 module.

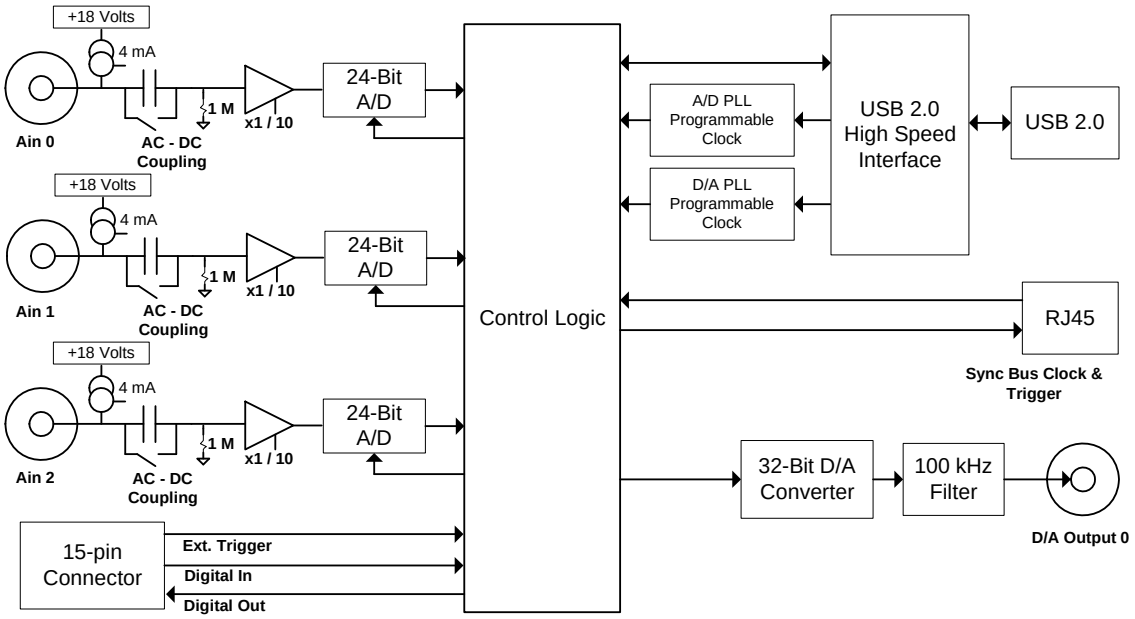

Figure 18: Block Diagram of the DT9847-3-1 Module

Analog Input Features

This section describes the following features of analog input (A/D) subsystem on the DT9847 Series modules:

- Analog input channels, described on this page
- IEPE functions, described on page 63
- Input resolution, described on page 63
- Input ranges and gains, described on page 62
- Input sample clock sources, described on page 63
- Analog input conversion modes, described on page 64
- Input triggers, described on page 66
- Data format and transfer, described on page 68
- Error conditions, described on page 69

Analog Input Channels

The DT9847-1-1 module provides one analog input channel (channel 0), the DT9847-2-2 provides two analog input channels (channels 0 and 1), and the DT9847-3-1 provides three analog input channels (channels 0 to 2). These are signal-ended channels; you can connect IEPE sensors to these inputs, if desired; refer to page 63 for more information on IEPE functions.

Note: To maintain simultaneous operation, all analog input connections on the DT9847 Series modules must have the same lead lengths.

The DT9847 Series modules use Delta-Sigma analog-to-digital converters (ADCs) that provide anti-aliasing filters based on the clock rate. These filters remove *aliasing*, which is a condition where high frequency input components erroneously appear as lower frequencies after sampling.

Using software, you can acquire a single value from a single analog input channel, a single value from all the analog input channels simultaneously (for the DT9847-2-2 and DT9847-3-1), or multiple values from a one or more analog input channels. Refer to "Analog Input Conversion Modes" on page 64 for more information on specifying and reading data from these channels.

Input Ranges and Gains

The DT9847 Series modules provide an input range of ±10 V and software-selectable gains of 1 and 10. This provides effective input ranges of ±10 V (when the gain is 1) and ±1 V (when the gain is 10).

IEPE Functions

Applications that require accelerometer, vibration, noise, or sonar measurements often use IEPE sensors. IEPE conditioning is built-in to the analog input circuitry of the DT9847 Series modules. The modules support the following software-programmable IEPE functions for each analog input channel:

- Excitation current source – The DT9847 Series modules provide an internal excitation current source of 4 mA. You can enable or disable the use of a internal excitation current source using software. By default, the excitation current source is disabled.
- Coupling type – You can select whether AC coupling or DC coupling is used. By default, DC coupling is selected for the DT9847 Series modules.

For information on wiring IEPE inputs, refer to page 38.

Note: If you enable the use of the internal excitation current source, it is recommended that you choose AC coupling.

Input Resolution

The resolution of the analog input channels is fixed at 24 bits; you cannot specify the resolution in software.

Input Clock Source

The DT9847 Series modules support an internal clock, which is derived from the USB clock.

Use software to specify the internal clock source and the frequency at which to pace the input and output operations and to start the sample clock. The sampling frequency ranges from 1 kHz to 216 kHz.

Note: According to sampling theory (Nyquist Theorem), specify a frequency that is at least twice as fast as the input's highest frequency component. For example, to accurately sample a 20 kHz signal, specify a sampling frequency of at least 40 kHz to avoid aliasing.

Once the sample clock is started, the module requires 63 conversions before the first A/D sample is valid. The valid sample is aligned with the A/D trigger.

On the DT9847, the sampling frequency is generated by a programmable clock chip rather than a divider off the reference clock for better flexibility and accuracy.

Configuration Delay

Due to the design of the A/D converter on the DT9847 Series, you may notice a delay after you configure the sampling frequency on the module (when the Config command is called). The delay is more significant at slower sampling frequencies.

The configuration delay is determined as follows:

- Sampling rate ≤ 50 kHz:

  Configuration delay = 8719 Samples/Sampling rate
- Sampling rate ≤ 100 kHz:

  Configuration delay = 17423 Samples/Sampling rate
- Sampling rate ≤ 216 kHz:

  Configuration delay = 34831 Samples/Sampling rate

For example, if you specify a sampling frequency of 1 kHz (sampling rate is 1 kSamples/s), the delay after you configure the sampling rate is 8.719 s, determined as follows:

8719 Samples/1 kSamples/s = 8.719 s

Similarly, if you specify a sampling frequency of 216 kHz (sampling rate is 216 kSamples/s), the delay after you configure the sampling rate is 0.161 s, determined as follows:

34831 Samples/216 kSamples/s = 0.161 s

Analog Input Conversion Modes

DT9847 Series modules support single-value, single-values, and continuous scan conversion modes. This section describes each of these conversion modes.

Single-Value Operations

Single-value operations are simpler to use than continuous operations. Using software, you specify the analog input channel and the gain that you want to use. For the DT9847-1-1, specify channel 0; for the DT9847-2-2, specify channel 0 or 1; for the DT9847-3-1, specify channel 0, 1, or 2. The module acquires the data from the specified channel and returns the data immediately.

For single-value operations, you cannot specify a clock source, trigger source, scan mode, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Single-Values Operations

For the DT9847-2-2 or DT9847-3-1 module, you may prefer to read a single value from all the analog input channels simultaneously using one software call. This is called a single-values operation. You specify the analog input subsystem and the gain that you want to use for the channels (not the channels themselves). The module then acquires a value from each input channel simultaneously; the data is returned as an array of input values.

For single-values operations, you cannot specify a clock source, trigger source, scan mode, or buffer. Single-values operations stop automatically when finished; you cannot stop a single-values operation.

Continuous Scan Mode

Continuous scan mode takes full advantage of the capabilities of the DT9847 Series modules. You can specify a channel list, clock source, start trigger, reference trigger, post-trigger scan count, and buffer using software.

On the DT9847-1-1 module, you can enter up to one entry in the channel list (analog input channel 0). On the DT9847-2-2 module, you can enter up to two entries in the channel list (analog input channels 0 and 1). On the DT9847-3-1 module, you can enter up to three entries in the channel list (analog input channels 0 to 2). Using software, specify the channels you want to sample in sequential order.

When it detects the start trigger, the module simultaneously acquires pre-trigger data from all of the input channels specified in the channel list. The sampled data is placed in the allocated buffer(s). When the reference trigger occurs, pre-trigger data acquisition stops and post-trigger acquisition starts. The operation continues until the number of samples you specify for the post-trigger scan count are acquired; at the point, the operation stops. Refer to page 66 for more information about triggers.

The conversion rate is determined by the frequency of the input sample clock; refer to page 63 for more information about the input sample clock.

Using software, you can stop a scan by performing either an orderly stop or an abrupt stop. In an orderly stop, the module finishes acquiring the current buffer, stops all subsequent acquisition, and transfers the acquired data to host memory; any subsequent triggers are ignored. In an abrupt stop, the module stops acquiring samples immediately; the current buffer is not completely filled, it is returned to the application only partially filled, and any subsequent triggers are ignored.

To select continuous scan mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify the clock source as internal and specify the clock frequency (refer to page 63)
- Specify the start trigger (refer to page 67)
- Specify the reference trigger (refer to page 68).
- Specify the post-trigger scan count (the number of post-trigger samples to acquire after the reference trigger occurs).

Figure 19 illustrates continuous scan mode (using a start and reference trigger) with a channel list of three entries: channel 0 through channel 2. In this example, pre-trigger analog input data is acquired when the start trigger is detected. When the reference trigger occurs, the specified number of post-trigger samples (3, in this example) are acquired.

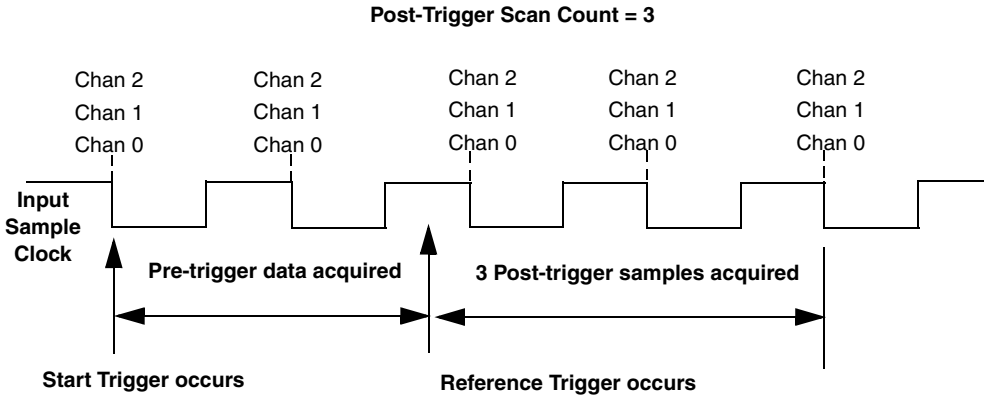

Figure 19: Continuous Scan Mode on the DT9847 Series Modules Using a Start and Reference Trigger

Note: The USB LED, shown in Figure 30 on page 123, blinks amber while the module is acquiring data.

The Trigger LED on the module, shown in Figure 30 on page 123, is green when the module is waiting for an external digital trigger, threshold trigger, or Sync Bus trigger (the module must have been configured for one of these trigger types), green when the module has been triggered, or off when the module is idle.

Input Triggers

A trigger is an event that occurs based on a specified set of conditions.

On the DT9847 Series modules, you can specify a start trigger source and a reference trigger source. Pre-trigger data acquisition starts when the start trigger event occurs. When the reference trigger event occurs, pre-trigger data acquisition stops and post-trigger acquisition starts. Post-trigger acquisition stops when the number of samples you specify for the post-trigger scan count has been reached. Refer to page 65 for more information.

The Trigger LED on the module, shown in Figure 30 on page 123, is green when the module is waiting for an external digital trigger, threshold trigger, or Sync Bus trigger (the module must have been configured for one of these trigger types), red when the module has been triggered, or off when the module is idle.

Start Trigger Sources

The DT9847 Series modules support the following sources for the start trigger:

- **Software trigger** – A software trigger event occurs when you start the analog input operation (the computer issues a write to the module to begin conversions). Using software, specify the start trigger source as a software trigger.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the module detects a rising- or falling-edge transition on the signal connected to the External Trigger pin (pin 13) of the Digital I/O and External Trigger connector on the module. Using software, specify the trigger source as an external, positive digital (TTL) trigger or an external, negative digital (TTL) trigger.

Note: If you configure the synchronization mode as slave, the Sync Bus connector accepts trigger and clock signals from the master; you cannot use the Ext Trig connector on the slave module. Refer to page 78 for more information.

- **Analog threshold trigger** – The start trigger event occurs when the signal attached to a specified analog input channel in the channel list rises above or falls below a user-specified threshold value. Using software, specify the following parameters:
  - Start trigger source – Specify a positive (low-to-high transition) threshold trigger if you want to trigger when the signal rises above a threshold level, or a negative (high-to-low transition) threshold trigger if you want to trigger when the signal falls below a threshold level.
  - Threshold channel – Specify any one of the analog input channels that are included in the channel list as the threshold input channel.
  - Threshold level – Specify a value between ±10 V for a gain of 1 or ±1 V for a gain of 10 as the threshold level.

Note: If you choose a threshold trigger as both the start trigger and the reference trigger, the threshold channel and threshold level must be the same. The polarity of the trigger (positive or negative going) can be different for each trigger source.

- **Sync Bus trigger** – When multiple DT9847 Series modules (or multiple DT9847 Series and DT9837 Series or DT9838 modules) are connected together using the Sync Bus (RJ45) connector, you can use the Sync Bus trigger as the start trigger of the slave module by setting the synchronization mode of module to Slave. In this configuration, any other start trigger for the slave module is ignored. Refer to page 78 for more information on this configuration.

Reference Trigger Sources

DT9847 Series modules support an analog threshold trigger for the reference trigger.

The reference trigger event occurs when the signal attached to a specified analog input channel in the channel list rises above or falls below a user-specified threshold value. Using software, specify the following parameters:

- Reference trigger source – Specify a positive (low-to-high transition) threshold trigger if you want to trigger when the signal rises above a threshold level, or a negative (high-to-low transition) threshold trigger if you want to trigger when the signal falls below a threshold level.
- Threshold channel – Specify any one of the analog input channels that are included in the channel list as the threshold input channel.
- Threshold level – Specify a value between ±10 V for a gain of 1 or ±1 V for a gain of 10 as the threshold level.

Note: If you choose a threshold trigger as both the start trigger and the reference trigger, the threshold channel and threshold level must be the same. The polarity of the trigger (positive or negative going) can be different for each trigger source.

- **Sync Bus trigger** – When multiple DT9847 Series modules (or multiple DT9847 Series and DT9837 Series or DT9838 modules) are connected together using the Sync Bus (RJ45) connector, you can set the reference trigger of a slave DT9847 Series module to Sync Bus if you want to receive a Sync Bus trigger from one of the other modules to stop pre-trigger acquisition and start post-trigger acquisition. Refer to page 78 for more information on this configuration.

Data Format and Transfer

DT9847 Series modules use offset binary data encoding, where 000000 represents negative full-scale, and FFFFFFh represents positive full-scale. Use software to specify the data encoding as binary. The ADC outputs FFFFFFh for above-range signals, and 000000 for below-range signals.

Before you begin acquiring data, you must allocate buffers to hold the data. A Buffer Done event is returned whenever a buffer is filled. This allows you to move and/or process the data as needed.

We recommend that you allocate a minimum of two buffers for continuous analog input operations. Data is written to multiple allocated input buffers continuously; when no more empty buffers are available, the operation stops. The data is gap-free.

Note: DT9847 Series modules have an 8 kSample input FIFO that is used to store the acquired data before it is sent to the host.

Error Conditions

DT9847 Series modules report any overrun errors by sending an overrun event to the application program. This event indicates that data buffers are not being sent from the module to the host fast enough, and the A/D converter ran out of buffers. To avoid this error, try one or more of the following:

- Reduce the clock rate of the A/D
- Increase the size of the buffers
- Increase the number of buffers
- Close any other applications that are running
- Run the program on a faster computer

If one of these error conditions occurs, the module stops acquiring and transferring data to the host computer.

Analog Output Features

This section describes the following features of analog output operations:

- Analog output channels, described below
- Output ranges and gains, described below
- Output resolution, described below
- Output clocks, described below
- Output conversion mode, described on page 71
- Output triggers, described on page 73
- Data format and transfer, described on page 74
- Error conditions, described on page 75

Analog Output Channels

The DT9847-1-1 and DT9847-3-1 modules support one analog output channel (0) through analog output subsystem 0. The DT9847-2-2 module supports two analog output channels (0 and 1) through analog output subsystem 0.

The DT9847 Series modules provide a two-pole, 100 kHz Butterworth filter to prevent noise from interfering with the output signal.

The analog output channel powers up to a value of 0 V ±10 mV.

Output Ranges and Gains

The DT9847 Series modules can output bipolar analog output signals in the range of ±3 V, with a gain of 1.

Output Resolution

The resolution of the analog output channel is fixed at 32-bits; you cannot specify the resolution in software.

Output Clocks

You can program the clock frequency for the D/A output clock on the DT9847 Series modules to value between 30 kHz and 216 kHz.

Use software to specify an internal clock source and to specify the clock frequency for the analog output subsystem.

Due to the group delay of the Delta-Sigma D/A converter, the DT9847 Series modules require 36 clock pulses once the analog output sample clock is started before the first D/A conversion is completed.

Output Conversion Modes

The DT9847 Series modules support single-value, waveform, and continuous analog output operations.

Single-Value Mode

Single-value mode is the simplest to use but offers the least flexibility and efficiency. Use software to specify the analog output channel that you want to update, and the value to output from that channel. The value is output from the specified channel immediately.

For a single-value operation, you cannot specify a clock source, trigger source, or buffer. Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Waveform Generation Mode

Waveform generation mode is supported on the DT9847 Series modules. In this mode, a waveform, which is specified in a single buffer, is output repetitively. The waveform pattern can range from 2 to 8192 samples if you are using one analog output channel or from 2 to 4096 if you are using two analog output channels. Use software to fill the output buffer with the values that you want to write to the channels in the output channel list.

Note: If you are using the DataAcq SDK, you must specify the data in a particular order. For example, if your output channel list contains analog output channels 0 and 1, specify the values in the output buffer as follows: the first output value for analog output channel 0, the first output value for analog output channel 1, the second output value for analog output channel 0, the second output value for analog output channel 1, and so on.

This is not required in the DT-Open Layers for .NET Class Library.

The host computer transfers the entire waveform pattern to the 8 kSample output FIFO on the module. When it detects a software trigger, the module starts writing output values to the analog output channels at the specified clock rate. The module recycles the data, allowing you to output the same pattern continuously without any further CPU or USB bus activity.

When it reaches the end of the FIFO, the module returns to the first location of the FIFO and continues outputting the data. This process continues indefinitely until you stop it.

To select waveform generation mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify WrapSingleBuffer as True to use a single buffer
- Specify the clock source as internal and specify the clock frequency. Refer to page 70 for more information about the clock source and frequency.
- Specify a software trigger source, described in the next section

The DT9847 Series hardware supports the ability to mute the output voltage to 0 V. Muting the output does not stop the analog output operation; instead, the analog output voltage is reduced to 0 V over 1020 samples. When desired, you can use unmute the output voltage to its current level. Refer to your software documentation for more information on muting and unmuting the output voltage.

Continuous Analog Output Operations

Use continuously paced analog output mode to continuously output buffered values to the analog output channel at a specified clock frequency. The DT9847 Series modules support the ability to start continuous analog output operations and continuous analog input operations simultaneously.

Note: If you are using the DataAcq SDK, you must specify the data in a particular order. For example, if your output channel list contains analog output channels 0 and 1, specify the values in the output buffer as follows: the first output value for analog output channel 0, the first output value for analog output channel 1, the second output value for analog output channel 0, the second output value for analog output channel 1, and so on.

This is not required in the DT-Open Layers for .NET Class Library.

When it detects a trigger, the module starts writing the values from the output buffer to the channels specified in the output channel list at the specified clock frequency. The operation repeats continuously until all the data is output from the buffers or you stop the operation.

Note: Make sure that the host computer transfers data to the output channel list fast enough so that the list does not empty completely; otherwise, an underrun error results.

To select continuously paced analog output mode, use software to specify the following parameters:

- Specify the data flow as Continuous
- Specify WrapSingleBuffer as False to use multiple buffers
- Specify the clock source as internal and specify the clock frequency. Refer to page 70 for more information about the clock source and frequency.
- Specify the trigger source as any of the supported trigger sources. Refer to page 73 for more information about the supported trigger sources.
- To start the analog input and analog output operations simultaneously using the DT-Open Layers for .NET Class Library, use the **SimultaneousStart.AddSubsystem, SimultaneousStart.PreStart**, and **SimultaneousStart.Start** methods. Refer to the documentation for the DT-Open Layers for .NET Class Library for more information.

We recommend that you allocate a minimum of two buffers for a continuously paced analog output operation. Data is written from multiple output buffers continuously; when no more buffers of data are available, the operation stops. The data is gap-free.

Note: The USB LED, shown in Figure 30 on page 123, blinks amber while the module is streaming the data to the analog output channels in continuous mode.

The DT9847 Series hardware supports the ability to mute the output voltage to 0 V. Muting the output does not stop the analog output operation; instead, the analog output voltage is reduced to 0 V over 1020 samples. When desired, you can use unmute the output voltage to its current level. Refer to your software documentation for more information on muting and unmuting the output voltage.

To stop a continuously paced analog output operation, you can stop queuing buffers for the analog output system, letting the module stop when it runs out of data, or you can perform either an orderly stop or an abrupt stop using software. In an orderly stop, the module finishes outputting the specified number of samples, and then stops; all subsequent triggers are ignored. In an abrupt stop, the module stops outputting samples immediately; all subsequent triggers are ignored.

Output Trigger

The DT9847 Series modules support the following trigger sources for starting analog output operations:

- **Software trigger** – A software trigger event occurs when you start the analog output operation (the computer issues a write to the module to begin conversions). Using software, specify the trigger source for the D/A subsystem as a software trigger.
- **External digital (TTL) trigger** – An external digital (TTL) trigger event occurs when the module detects a rising- or falling-edge transition on the signal connected to the External Trigger pin (pin 13) of the Digital I/O and External Trigger connector on the module. Using software, specify the trigger source for the D/A subsystem as an external, positive digital (TTL) trigger or an external, negative digital (TTL) trigger.

  Note: If you configure the synchronization mode as slave, the Sync Bus connector accepts trigger and clock signals from the master; you cannot use the Ext Trig connector on the slave module. Refer to page 78 for more information.

- **Sync Bus trigger** – When multiple DT9847 Series modules (or multiple DT9847 Series and DT9837 Series or DT9838 modules) are connected together using the Sync Bus (RJ45) connector, you can use the Sync Bus trigger as the start trigger of the slave module by setting the synchronization mode of module to Slave. In this configuration, any other start trigger for the slave module is ignored. Refer to page 78 for more information on this configuration.

Data Format and Transfer

Data from the host computer must use offset binary data encoding for analog output signals, where 00000000 represents –3 V, and FFFFFFFFh represents +3 V. Using software, specify the data encoding as binary.

Error Conditions

The DT9847 Series modules report any underrun errors by sending an underrun event to the application. This event indicates that the data buffers are not being sent from the host to the module fast enough, and the D/A converter ran out of data. To avoid this error, try one or more of the following:

- Reduce the clock rate of the analog output operation
- Close any other applications that are running
- Run the program on a faster computer

Digital I/O Features

This section describes the following features of digital I/O operations:

- Digital I/O lines, described below
- Operation modes, described below

Digital I/O Lines

The DT9847 Series modules support one digital input port, consisting of 4 digital input lines (lines 0 to 3) and one digital output port, consisting of 4 digital output lines (lines 0 to 3). The resolution is fixed at 4 bits; you cannot change the resolution in software.

You can read all 4 digital input lines or write all 4 digital output lines with a single-value digital I/O operation.

A digital line is high if its value is 1; a digital line is low if its value is 0. On power up or reset, a low value (0) is output from each of the digital output lines.

Operation Modes

The DT9847 Series modules support single-value digital I/O operations. You use software to specify the digital I/O port (the gain is ignored). Data is then read from or written to all the digital I/O lines.

Single-value operations stop automatically when finished; you cannot stop a single-value operation.

Triggering Acquisition on Multiple Modules

Note: For DT9847 Series modules, you can synchronize acquisition on multiple modules using the Sync Bus (RJ45) connector, described on page 78.

The internal clock on the DT9847 Series modules when the synchronization mode is none (see page 78), is derived from the USB clock and provides the timing for both the analog input and analog output subsystems on the module.

You can start acquisition on multiple modules by connecting all modules to a shared external trigger input, as shown in Figure 20. When triggered, the modules start acquiring data at the same time.

Using this connection scheme, the measurements of one module may not be synchronous with the measurements of another module due to logic delays in the clocking and USB circuitry.

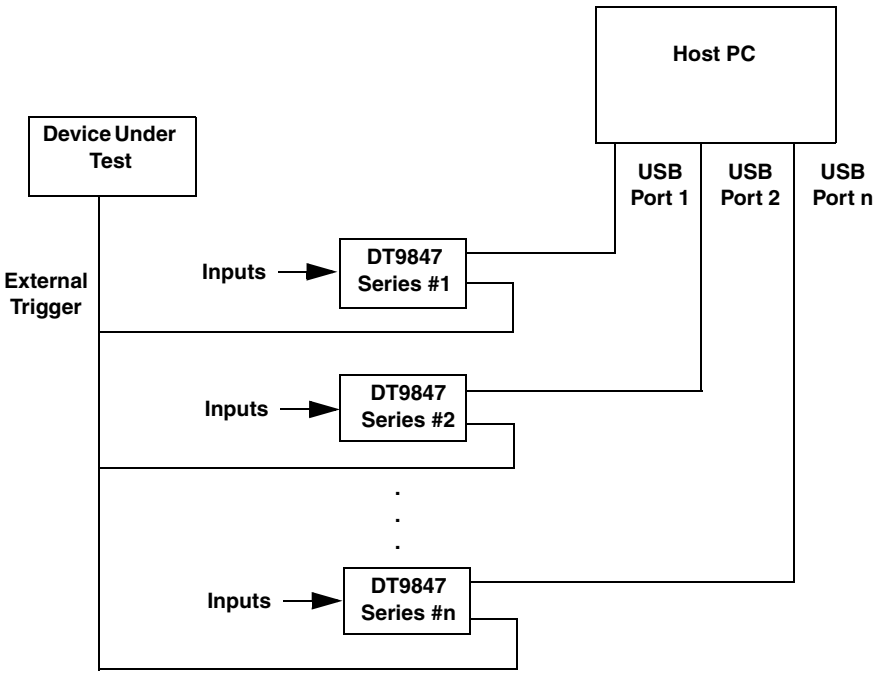

Figure 20: Triggering Multiple Modules Using an External Trigger Source

Synchronizing Acquisition on Multiple DT9847 Series Modules

DT9847 Series modules provide a Sync Bus (RJ45) connector that you can use to connect and synchronize multiple DT9847 Series modules.

Note: Note that you can also connect DT9837A, DT9837B, DT9837C, and/or DT9838 modules to a DT9847 Series module in this configuration. Refer to the *DT9837 Series User's Manual* and the *DT9838 User's Manual* for more information.

In this scheme, one module is the master and the other modules are the slave. You specify the synchronization mode (master, slave, or none) of the A/D subsystem using software.

When configured as a master, the Sync Bus connector outputs trigger and clock signals. When configured as a slave, the Sync Bus connector accepts trigger and clock signals from the master; the start trigger source on the slave module in is ignored in this configuration since the Sync Bus is used as the start trigger. When configured as none (the default mode), the DT9847 Series module uses the USB clock instead of the Sync Bus connector. The synchronization mode remains set until changed or until the application exits.

You can connect multiple modules in one of two ways. Figure 21 shows how to connect a maximum of two DT9847 Series modules by daisy chaining them together through the Sync Bus connector. Figure 22 shows how to connect a maximum of four DT9847 Series modules by using an RJ45 distribution panel, such as the EP386, where the panel contains four RJ45 connectors that are wired in parallel.

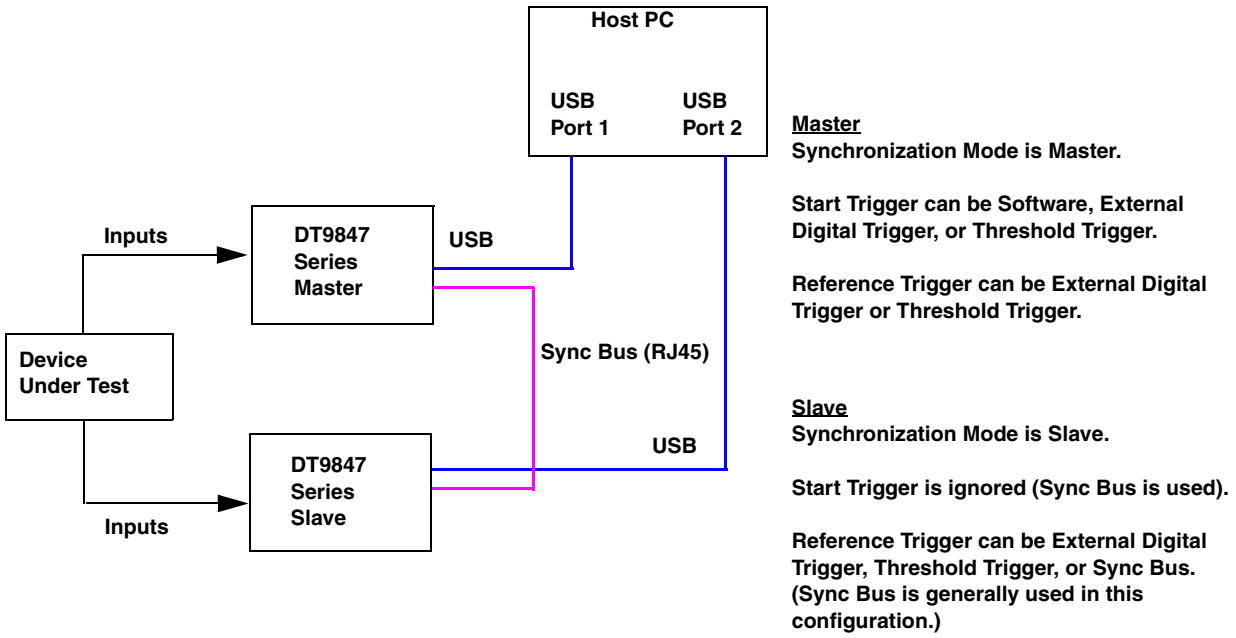
Host PC
USB Port 1
USB Port 2
Inputs
DT9847 Series Master
USB
Device Under Test
Sync Bus (RJ45)
USB
DT9847 Series Slave
Inputs
Master
Synchronization Mode is Master.
Start Trigger can be Software, External Digital Trigger, or Threshold Trigger.
Reference Trigger can be External Digital Trigger or Threshold Trigger.
Slave
Synchronization Mode is Slave.
Start Trigger is ignored (Sync Bus is used).
Reference Trigger can be External Digital Trigger, Threshold Trigger, or Sync Bus. (Sync Bus is generally used in this configuration.)

Figure 21: Synchronizing Two DT9847 Series Modules by Daisy Chaining the Sync Bus Connectors

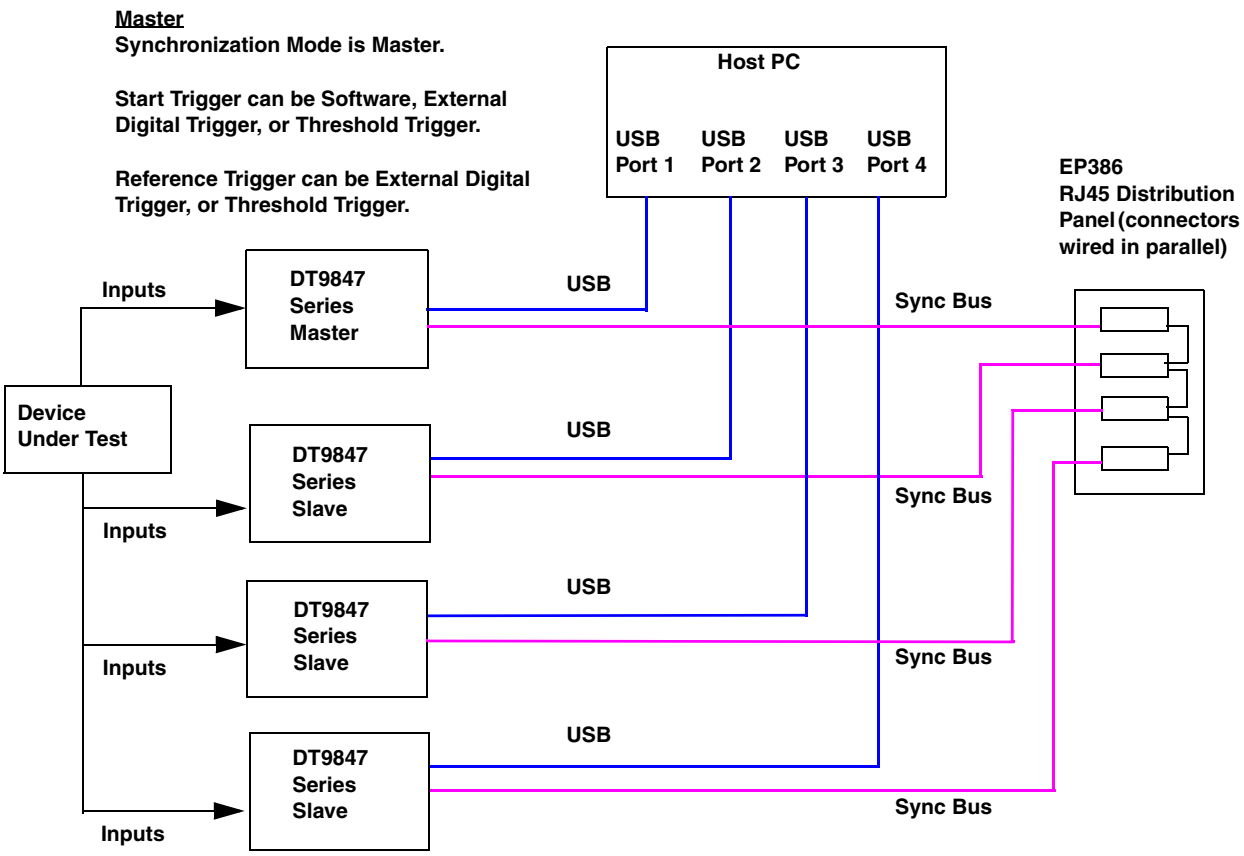
Master
Synchronization Mode is Master.
Start Trigger can be Software, External Digital Trigger, or Threshold Trigger.
Reference Trigger can be External Digital Trigger, or Threshold Trigger.
Host PC
USB Port 1
USB Port 2
USB Port 3
USB Port 4
EP386 RJ45 Distribution Panel (connectors wired in parallel)
Inputs
DT9847 Series Master
USB
Sync Bus
Device Under Test
DT9847 Series Slave
Inputs
USB
Sync Bus
DT9847 Series Slave
Inputs
USB
Sync Bus
DT9847 Series Slave
Inputs
USB
Sync Bus
Slave
Synchronization Mode is Slave.
Start Trigger is ignored (Sync Bus is used).
Reference Trigger can be External Digital Trigger, Threshold Trigger, or Sync Bus. (Sync Bus is generally used in this configuration.)
* The RJ45 cables must be less than 1 foot in length. For minimum clock skew, the master module must be less than 4 inches away from the RJ45 distribution panel.

Figure 22: Synchronizing Four DT9847 Series Modules Using the EP386 RJ45 Distribution Panel (Shown Using an External Trigger)

When synchronizing multiple modules, start the slave modules before starting the master module. When the master DT9847 Series module is triggered (using the software trigger, external digital trigger, or threshold trigger), both the master and the slave modules start acquiring data at the same time (within one A/D conversion of the clock). Note that you can set the clock rate to be the same or different on each module.

Note: It is important that you start the slave modules first, followed by the master module so that the slave receives the appropriate clock and trigger signals from the master.

If you start the master module before the slaves, the slaves never start; you will see a delay of approximately 20 seconds if you try to stop or abort the analog input operation on a slave module that is waiting for a trigger.

When you stop the master module, the slaves continue to run and return data until you stop the analog input subsystem on the slave modules. Be sure to stop the analog input subsystems on all slave modules before disconnecting the cable from the Sync Bus connectors.

Triggering DT9847 and DT9837 Series Modules Using the Sync Bus

If you are connecting the DT9847 Series module to a DT9837 Series module using the Sync Bus connector, be aware of triggering limitations.

Note: There are no triggering limitations when connecting a DT9847 Series module to a DT9838 module using the Sync Bus connector; follow the instructions on page 79 when connecting a DT9838 module.

The DT9837 Series supports the following start trigger sources: software, external digital trigger, and threshold trigger. For the reference trigger, the DT9837 Series supports only the threshold trigger source. When configured as a slave, the DT9837 Series processes a single Sync Bus trigger; the Sync Bus trigger is considered the start trigger and is received and/or driven out as such.

Consider the case where the DT9847 Series module is the master and a DT9837 Series module is the slave, as shown in Figure 23.

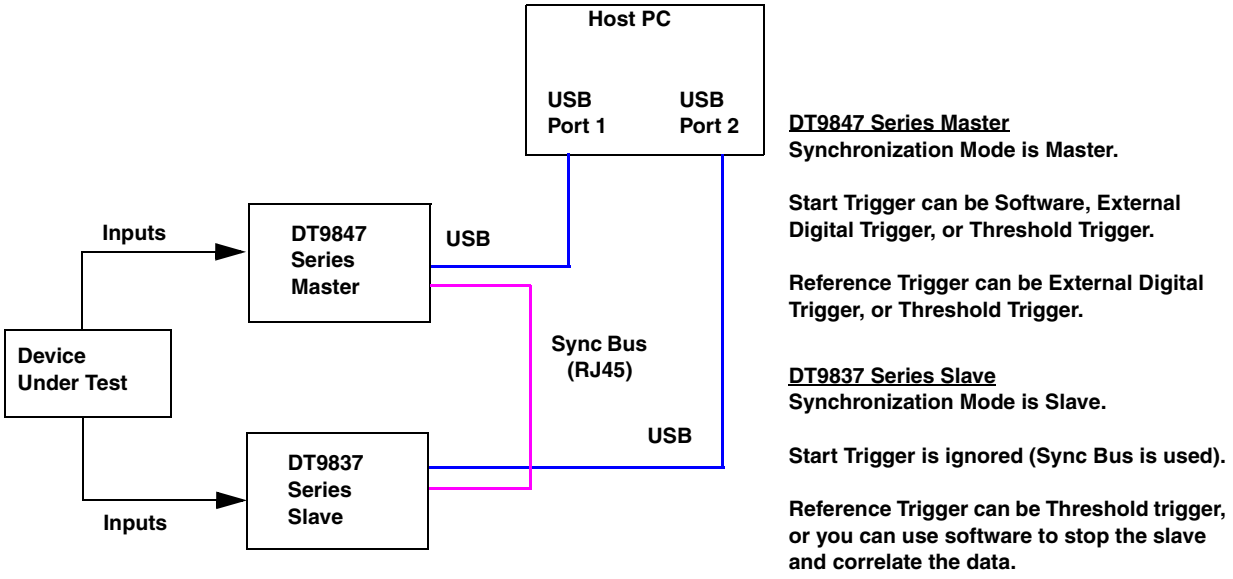
Host PC
USB Port 1
USB Port 2
DT9847 Series Master
Synchronization Mode is Master.
Start Trigger can be Software, External Digital Trigger, or Threshold Trigger.
Reference Trigger can be External Digital Trigger, or Threshold Trigger.
DT9837 Series Slave
Synchronization Mode is Slave.
Start Trigger is ignored (Sync Bus is used).
Reference Trigger can be Threshold trigger, or you can use software to stop the slave and correlate the data.
Inputs
DT9847 Series Master
USB
Sync Bus (RJ45)
USB
Device Under Test
DT9837 Series Slave
Inputs

Figure 23: Synchronizing a Master DT9847 Series Module and a Slave DT9837 Series Module Using the Sync Bus Connector

In this case, the start trigger on the master DT9847 Series module can be a software trigger, external digital trigger, or threshold trigger. The reference trigger on the master DT9847 Series module can be an external digital trigger or threshold trigger.

The start trigger on the slave DT9837 Series module is ignored, since the Sync Bus is used as the start trigger. The reference trigger on the slave DT9837 Series can be the threshold trigger, or you can use software to stop the DT9837 Series module and correlate the data.

Now, consider the case where the DT9837 Series is the master and a DT9847 Series module is the slave, as shown in Figure 24.

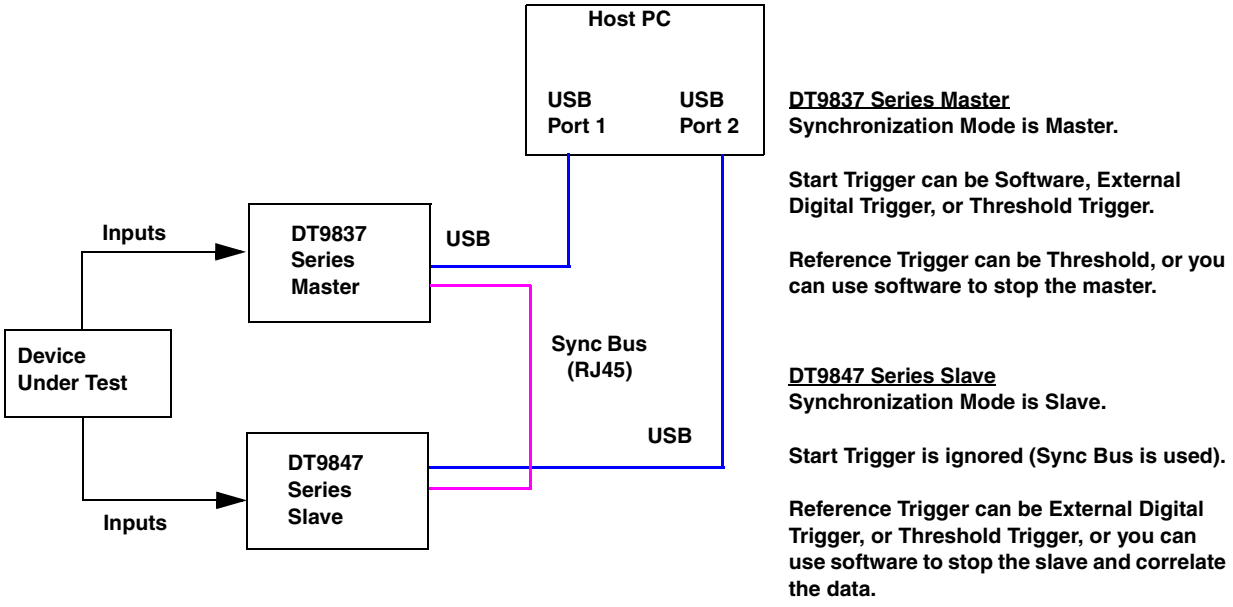
Host PC
USB Port 1
USB Port 2
DT9837 Series Master
Synchronization Mode is Master.
Start Trigger can be Software, External Digital Trigger, or Threshold Trigger.
Reference Trigger can be Threshold, or you can use software to stop the master.
Inputs
DT9837 Series Master
USB
Sync Bus (RJ45)
Device Under Test
USB
DT9847 Series Slave
Synchronization Mode is Slave.
Start Trigger is ignored (Sync Bus is used).
Reference Trigger can be External Digital Trigger, or Threshold Trigger, or you can use software to stop the slave and correlate the data.
Inputs

Figure 24: Synchronizing a Master DT9837 Series Module and a Slave DT9847 Series Module Using the Sync Bus Connector

In this case, the start trigger on the master DT9837 Series module can be a software, external digital, or threshold trigger. The reference trigger on the master DT9837 Series module can be the threshold trigger.

The start trigger on the slave DT9847 Series module is ignored, since the Sync Bus is used as the start trigger. The reference trigger on the slave DT9847 Series module can be an external digital trigger or threshold trigger (the Sync Bus trigger is not supported as a reference trigger in this configuration), or you can use software to stop the DT9847 Series module and correlate the data.

Supported Device Driver Capabilities

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The DT9847 Series Device Drivers provide support for the analog input (A/D) and analog output (D/A) subsystems. For information on how to configure the device drivers, refer to page 34.

Table 2: DT9847 Series Subsystems

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Total Subsystems on Module	1	1	1	1	0	0	0

The tables in this chapter summarize the features available for use with the DT-Open Layers for .NET Class Library and the DT9847 Series modules. The DT-Open Layers for .NET Class Library provides properties that return support information for specified subsystem capabilities.

The first row in each table lists the subsystem types. The first column in each table lists all possible subsystem capabilities. A description of each capability is followed by the property used to describe that capability in the DT-Open Layers for .NET Class Library.

Note: The following tables include the capabilities that can be queried. However, some capabilities may not be supported by your device. Blank fields represent unsupported options.

For more information, refer to the description of these properties in the DT-Open Layers for .NET Class Library online help or *DT-Open Layers for .NET Class Library User's Manual*.

Data Flow and Operation Options

Table 3: Data Flow and Operation Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Single-Value Operation Support **SupportsSingleValue**	Yes	Yes	Yes	Yes			
Simultaneous Single-Value Output Operations **SupportsSetSingleValues**							
Continuous Operation Support **SupportsContinuous**	Yes	Yes					
Continuous Operation until Trigger **SupportsContinuousPreTrigger**							
Continuous Operation before & after Trigger **SupportsContinuousPrePostTrigger**							
Waveform Operations Using FIFO Only **SupportsWaveformModeOnly**		Yes[a]					
Simultaneous Start List Support **SupportsSimultaneousStart**	Yes[b]	Yes[b]					
Supports Programmable Synchronization Modes **SupportsSynchronization**							
Synchronization Modes **SynchronizationMode**							
Interrupt Support **SupportsInterruptOnChange**							
Output FIFO Size **FifoSize**		8 kSamples					
Muting and Unmuting the Output Voltage **SupportsMute**		Yes					
Auto-Calibrate Support **SupportsAutoCalibrate**							

a. The DT9847 Series modules support continuous analog output operations in addition to waveform mode.
b. The DT9847 Series modules support the ability to start continuous A/D and continuous D/A operations simultaneously.

Buffering

Table 4: Buffering Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Buffer Support **SupportsBuffering**	Yes	Yes					
Single Buffer Wrap Mode Support **SupportsWrapSingle**	Yes	Yes					
Inprocess Buffer Flush Support **SupportsInProcessFlush**	Yes						

Triggered Scan Mode

Table 5: Triggered Scan Mode Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Triggered Scan Support **SupportsTriggeredScan**							
Maximum Number of CGL Scans per Trigger **MaxMultiScanCount**	1	0	0	0	0		0
Maximum Retrigger Frequency **MaxRetriggerFreq**	0	0	0	0	0		0
Minimum Retrigger Frequency **MinRetriggerFreq**	0	0	0	0	0		0

Data Encoding

Table 6: Data Encoding Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Binary Encoding Support **SupportsBinaryEncoding**	Yes	Yes	Yes	Yes			
Twos Complement Support **SupportsTwosCompEncoding**							
Returns Floating-Point Values **ReturnsFloats**							

Channels

Table 7: Channel Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Channels **NumberOfChannels**	1, 2, or 3[a]	1 or 2[b]	1	1			
SE Support **SupportsSingleEnded**	Yes	Yes	Yes	Yes			
SE Channels **MaxSingleEndedChannels**	1, 2, or 3[a]	1 or 2[b]	1	1			
DI Support **SupportsDifferential**							
DI Channels **MaxDifferentialChannels**	0	0	0	0			
Maximum Channel-Gain List Depth **CGLDepth**	1, 2, or 3[a]	1 or 2[b]	0	0			
Simultaneous Sample-and-Hold Support **SupportsSimultaneousSampleHold**	Yes						
Channel-List Inhibit **SupportsChannelListInhibit**							

a. The DT9847-1-1 supports one analog input channel; the DT9847-2-2 supports two analog input channels; and the DT9847-3-1 supports three analog input channels.

b. The DT9847-1-1 and DT9847-3-1 modules support one analog output channel, and the DT9847-2-2 module supports two analog output channels.

Gain

Table 8: Gain Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Programmable Gain Support **SupportsProgrammableGain**	Yes						
Number of Gains **NumberOfSupportedGains**	2	1	0	0	0		0
Gains Available **SupportedGains**	1 and 10	1					

Ranges

Table 9: Range Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Number of Voltage Ranges **NumberOfRanges**	1	1	0	0			
Available Ranges **SupportedVoltageRanges**	±10 V[a]	±3 V					
Current Output Support **SupportsCurrentOutput**							

a. By applying a gain of 1, the effective input range is ±10 V. By applying a gain of 10, the effective input range is ±1 V.

Resolution

Table 10: Resolution Options

DT9847 Series Modules	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Programmable Resolution **SupportsSoftwareResolution**							
Number of Resolutions **NumberOfResolutions**	1	1	1	1			
Available Resolutions **SupportedResolutions**	24	32	4	4			

Thermocouple and RTD Support

Table 11: Thermocouple and RTD Support Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Thermocouple Support **SupportsThermocouple**							
RTD Support **SupportsRTD**							
Resistance Support **ReturnsOhms**							
Voltage Converted to Temperature in Hardware **SupportsTemperatureDataInStream**							
Supported Thermocouple Types **ThermocoupleType**							
Supported RTD Types **RTDType**							
Supports CJC Source Internally in Hardware **SupportsCjcSourceInternal**							
Supports CJC Channel **SupportsCjcSourceChannel**							
Available CJC Channels **CjcChannel**							
Supports Interleaved CJC Values in Data Stream **SupportsInterleavedCjcTemperaturesInStream**							
Supports Programmable Filters **SupportsTemperatureFilters**							
Programmable Filter Types **TemperatureFilterType**							

IEPE Support

Table 12: IEPE Support Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Programmable AC Coupling **SupportsACCoupling**	Yes						
Software Programmable DC Coupling **SupportsDCCoupling**	Yes						
Software Programmable External Excitation Current Source **SupportsExternalExcitationCurrentSrc**							
Software Programmable Internal Excitation Current Source **SupportsInternalExcitationCurrentSrc**	Yes						
Available Excitation Current Source Values **SupportedExcitationCurrentValues**	.004 A						

Strain Gage Support

Table 13: Strain Gage Support Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Strain Gage Support **SupportsStrainGage**							
External Excitation Voltage **SupportsExternalExcitationVoltage**							
Internal Excitation Voltage **SupportsInternalExcitationVoltage**							
Shunt Calibration **SupportsShuntCalibration**							
Voltage Excitation Per Channel **SupportedPerChannelVoltageExcitation**							
Minimum Excitation Voltage **MinExcitationVoltage**							
Maximum Excitation Voltage **MaxExcitationVoltage**							

Start Triggers

Table 14: Start Trigger Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Software Trigger Support **SupportsSoftwareTrigger**	Yes	Yes	Yes	Yes			
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**	Yes	Yes					
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**	Yes	Yes					
External Positive TTL Trigger Support for Single-Value Operations **SupportsSvPosExternalTTLTrigger**							
External Negative TTL Trigger Support for Single-Value Operations **SupportsSvNegExternalTTLTrigger**							
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**	Yes[a]						
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**	Yes[a]						
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Threshold Trigger Channel **SupportedThresholdTriggerChannel**	0 (DT9847-1-1), 0 or 1 (DT9847-2-2, 0, 1, 2 (DT9847-3-1)[a]	0					

a. If you choose a threshold trigger for the start trigger on the DT9847 Series module, you can program the threshold level as a value between ±10 V for a gain of 1 or ±1 V for a gain of 10, and any of the supported analog input channels can be used as the threshold channel.

Reference Triggers

Table 15: Reference Trigger Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
External Positive TTL Trigger Support **SupportsPosExternalTTLTrigger**	Yes						
External Negative TTL Trigger Support **SupportsNegExternalTTLTrigger**	Yes						
Positive Threshold Trigger Support **SupportsPosThresholdTrigger**	Yes[a]						
Negative Threshold Trigger Support **SupportsNegThresholdTrigger**	Yes[a]						
Digital Event Trigger Support **SupportsDigitalEventTrigger**							
Threshold Trigger Channel **SupportedThresholdTriggerChannel**	0 (DT9847-1-1), 0 or 1 (DT9847-2-2, 0, 1, 2 (DT9847-3-1)[a]						
Post-Trigger Scan Countl **SupportsPostTriggerScanCount**	Yes[b]						

a. If you choose a threshold trigger for the reference trigger on the DT9847 Series module, you can program the threshold level as a value between ±10 V for a gain of 1 or ±1 V for a gain of 10, and any of the supported analog input channels can be used as the threshold channel.

b. You can specify how many post-trigger samples to acquire after the reference trigger by specifying the post-trigger scan count in software.

Clocks

Table 16: Clock Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Internal Clock Support **SupportsInternalClock**	Yes	Yes					
External Clock Support **SupportsExternalClock**							
Simultaneous Input/Output on a Single Clock Signal **SupportsSimultaneousClocking**	Yes						
Base Clock Frequency **BaseClockFrequency**	13.824 MHz	41.472 MHz	0	0			
Maximum Clock Divider **MaxExtClockDivider**	1.0	1.0	1.0	1.0			
Minimum Clock Divider **MinExtClockDivider**	1.0	1.0	1.0	1.0			
Maximum Frequency **MaxFrequency**	216 kHz	216 kHz	0	0			
Minimum Frequency **MinFrequency**	1 kHz	30 kHz	0	0			

Counter/Timers

Table 17: Counter/Timer Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Cascading Support **SupportsCascading**							
Event Count Mode Support **SupportsCount**							
Generate Rate Mode Support **SupportsRateGenerate**							
One-Shot Mode Support **SupportsOneShot**							
Repetitive One-Shot Mode Support **SupportsOneShotRepeat**							
Up/Down Counting Mode Support **SupportsUpDown**							
Edge-to-Edge Measurement Mode Support **SupportsMeasure**							
Continuous Edge-to-Edge Measurement Mode Support **SupportsContinuousMeasure**							
High to Low Output Pulse Support **SupportsHighToLowPulse**							
Low to High Output Pulse Support **SupportsLowToHighPulse**							
Variable Pulse Width Support **SupportsVariablePulseWidth**							
None (internal) Gate Type Support **SupportsGateNone**							
High Level Gate Type Support **SupportsGateHighLevel**							
Low Level Gate Type Support **SupportsGateLowLevel**							
High Edge Gate Type Support **SupportsGateHighEdge**							
Low Edge Gate Type Support **SupportsGateLowEdge**							
Level Change Gate Type Support **SupportsGateLevel**							
Clock-Falling Edge Type **SupportsClockFalling**							
Clock-Rising Edge Type **SupportsClockRising**							
Gate-Falling Edge Type **SupportsGateFalling**							
Gate-Rising Edge Type **SupportsGateRising**							
Interrupt-Driven Operations **SupportsInterrupt**							

Tachometers

Table 18: Tachometer Options

DT9847 Series	A/D	D/A	DIN	DOUT	C/T	TACH	QUAD
Tachometer Falling Edges **SupportsFallingEdge**							
Tachometer Rising Edges **SupportsRisingEdge**							
Tachometer Stale Data Flag **SupportsStaleDataFlag**							

Troubleshooting

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General Checklist

Should you experience problems using a DT9847 Series module, do the following:

1. Read all the documentation provided for your product. Make sure that you have added any "Read This First" information to your manual and that you have used this information.
2. Check the OMNI CD for any README files and ensure that you have used the latest installation and configuration information available.
3. Check that your system meets the requirements stated in the README file on the OMNI CD.
4. Check that you have installed your hardware properly using the instructions in Chapter 2.
5. Check that you have installed and configured the device driver for your module using the instructions in Chapter 2.
6. Check that you have wired your signals properly using the instructions in Chapter 3.
7. Search the DT Knowledgebase in the Support section of the Data Translation web site (at www.datatranslation.com) for an answer to your problem.

If you still experience problems, try using the information in Table 19 to isolate and solve the problem. If you cannot identify the problem, refer to page 98.

Table 19: Troubleshooting Problems

Symptom	Possible Cause	Possible Solution
Module is not recognized	You plugged the module into your computer before installing the device driver.	From the Control Panel > System > Hardware > Device Manager, uninstall any unknown devices (showing a yellow question mark). Then, run the setup program on your OMNI CD to install the USB device drivers, and reconnect your USB module to the computer.
Module does not respond	The module configuration is incorrect.	Check the configuration of your device driver; see the instructions in Chapter 2.
	The module is damaged.	Contact Data Translation for technical support; refer to page 98.
Intermittent operation	Loose connections or vibrations exist.	Check your wiring and tighten any loose connections or cushion vibration sources; see the instructions in Chapter 3.
	The module is overheating.	Check environmental and ambient temperature; consult the module's specifications on page 115 of this manual and the documentation provided by your computer manufacturer for more information.
	Electrical noise exists.	Check your wiring and either provide better shielding or reroute unshielded wiring; see the instructions in Chapter 3.

Table 19: Troubleshooting Problems (cont.)

Symptom	Possible Cause	Possible Solution
Device failure error reported	The DT9847 Series module cannot communicate with the Microsoft bus driver or a problem with the bus driver exists.	Check your cabling and wiring and tighten any loose connections; see the instructions in Chapter 3.
	The DT9847 Series module was removed while an operation was being performed.	Ensure that your module is properly connected; see the instructions in Chapter 2.
Data appears to be invalid	An open connection exists.	Check your wiring and fix any open connections; see the instructions in Chapter 3.
	A transducer is not connected to the channel being read.	Check the transducer connections; see the instructions in Chapter 3.
	The module is set up for differential inputs while the transducers are wired as single-ended inputs or vice versa.	Check your wiring and ensure that what you specify in software matches your hardware configuration; see the instructions in Chapter 3.
	The module is out of calibration.	DT9847 Series modules are calibrated at the factory. If you want to readjust the calibration of the analog input or analog output circuitry, refer to Chapter 8.
USB 2.0 is not recognized	Your operating system does not have the appropriate Service Pack installed.	Ensure that you load the appropriate Windows Service Pack (version 2 for Windows XP). If you are unsure of whether you are using USB 2.0 or USB 1.1, run the Open Layers Control Panel applet, described in Chapter 2.
	Standby mode is enabled on your PC.	For some PCs, you may need to disable standby mode on your system for proper USB 2.0 operation. Consult Microsoft for more information.

Technical Support

If you have difficulty using a DT9847 Series module, Data Translation's Technical Support Department is available to provide technical assistance.

To request technical support, go to our web site at http://www.datatranslation.com and click on the Support link.

When requesting technical support, be prepared to provide the following information:

- Your product serial number
- The hardware/software product you need help on
- The version of the OMNI CD you are using
- Your contract number, if applicable

If you are located outside the USA, contact your local distributor; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor.

If Your Module Needs Factory Service

If your module must be returned to Data Translation, do the following:

1. Record the module's serial number, and then contact the Customer Service Department at (508) 481-3700, ext. 1323 (if you are in the USA) and obtain a Return Material Authorization (RMA).

   If you are located outside the USA, call your local distributor for authorization and shipping instructions; see our web site (www.datatranslation.com) for the name and telephone number of your nearest distributor. All return shipments to Data Translation must be marked with the correct RMA number to ensure proper processing.

2. Using the original packing materials, if available, package the module as follows:

   – Wrap the module in an electrically conductive plastic material. Handle with ground protection. A static discharge can destroy components on the module.

   – Place in a secure shipping container.

3. Return the module to the following address, making sure the RMA number is visible on the outside of the box.

   Customer Service Dept.
   Data Translation, Inc.
   100 Locke Drive
   Marlboro, MA 01752-1192

Calibration

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DT9847 Series modules are calibrated at the factory and should not require calibration for initial use. We recommend that you check and, if necessary, readjust the calibration of the analog input and analog output circuitry every six months using the DT9847 Series Calibration Utility.

Note: Ensure that you installed the device driver for your module using the Data Acquisition OMNI CD prior to using the calibration utility.

This chapter describes how to calibrate the analog input and output subsystems of a DT9847 Series module using the calibration utility.

Using the Calibration Utility

Start the DT9847 Series Calibration Utility as follows:

1. Click **Start** from the Task Bar.
2. For the DT9847 module, select **Programs | Data Translation, Inc | Calibration | DT9847 Series Calibration Utility.**
   The main window of the DT9847 Series Calibration Utility appears.
3. Select the module to calibrate, and then click **OK**.

Note: When you first run the DT9847 Series Calibration Utility, you may notice a delay before you can start using the utility. This is the configuration delay that is related to the sampling frequency, as described on page 64.

Once the calibration utility is running, you can calibrate the analog input circuitry (either automatically or manually), described on page 104, or the analog output circuitry of the module, described on page 106.

Calibrating the Analog Input Subsystem

This section describes how to use the calibration utility to calibrate the analog input subsystem of a DT9847 Series module.

DT9847 Series modules have separate calibration for each A/D input channel.

Warming up the Module

Before calibrating the analog input circuitry, ensure that the module has been powered on for at least one hour.

Connecting a Precision Voltage Source

To calibrate the analog input circuitry, you need to connect an external +9.3750 V precision voltage source to the DT9847 Series module. Connect the precision voltage source to the first channel you want to calibrate; for example, Analog In 0 (AD Ch0).

Using the Auto-Calibration Procedure

Auto-calibration is the easiest to use and is the recommended calibration method. To auto-calibrate the analog input subsystem, do the following:

1. Select the **A/D Calibration** tab of the calibration utility.
2. Under the **Calibration Settings** area of the window, select the sampling frequency, in Hertz, and the gain that you want to use.

Note: By default, this utility uses DC coupling with the current source disabled. This is the recommended setting for most users. While changing these settings is not advised for most users, users with unique applications can change these settings by clicking the **Advanced** button.

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3. Under the Automatic Calibration area of the window, select the channel that you want to calibrate from the **Type of Calibration** drop-down list box, and then click the **Start** button. *A message appears notifying you to verify that 0.000 V is applied to the channel.*
4. Verify that the supplied voltage to your selected channel is 0.000 V, and then click **OK**. *The offset value is calibrated. When the offset calibration is complete, a message appears notifying you to set the input voltage of the channel to +9.375 V.*
5. Check that the supplied voltage to your selected channel is +9.375 V, and then click **OK**. *The gain value is calibrated and a completion message appears.*
6. Repeat these steps for each analog input channel on the module.

Note: At any time, you can click **Restore Factory Settings** to reset the A/D calibration values to their original factory settings. This process will undo any auto or manual calibration settings.

Using the Manual Calibration Procedure

If you want to manually calibrate the analog input circuitry instead of auto-calibrating it, do the following for each channel:

1. Select the **A/D Calibration** tab of the calibration utility.
2. Under the **Calibration Settings** area of the window, select the sampling frequency, in Hertz, and the gain that you want to use.

Note: By default, this utility uses DC coupling with the current source disabled. This is the recommended setting for most users. While changing these settings is not advised for most users, users with unique applications can change these settings by clicking the **Advanced** button.

3. Under the Manual Calibration area of the window, select the channel that you want to calibrate, and then click the **Start** button.
4. Adjust the offset as follows:
   a. Verify that 0.000 V is applied to the channel that you want to calibrate.
   The current voltage reading for this channel is displayed in the AD Value box.
   b. Adjust the offset by entering values between 0 and 255 in the **Offset** edit box, or by clicking the up/down buttons until the **AD Value** is 0.000 V.
5. Adjust the gain as follows:
   a. Verify that +9.375 V is applied to the channel that you want to calibrate.
   The current voltage reading for this channel is displayed in the AD Value box.
   b. Adjust the gain by entering values between 0 and 255 in the **Gain** edit box, or by clicking the up/down buttons until the **AD Value** is 9.3750 V.
6. When you have finished calibrating the channel, click the **Stop** button.
7. Repeat these steps for each analog input channel on the module.

Note: At any time, you can click **Restore Factory Settings** to reset the A/D calibration values to their original factory settings. This process will undo any auto or manual calibration settings.

Once you have finished this procedure, continue with "Calibrating the Analog Output Subsystem."

Calibrating the Analog Output Subsystem

To calibrate the analog output circuitry, you need to connect an external precision voltmeter to the analog output channels of the DT9847 Series module.

Do the following to calibrate the analog output circuitry:

1. Select the **D/A Calibration** tab of the calibration utility.
2. Under the Channel Selection area of the window, select the analog output channel of the DT9847 Series module to calibrate
3. Connect an external precision voltmeter to the selected analog output channel.
4. In the DAC Output Voltage box, select **0 V**.
5. Adjust the offset by entering values between 0 and 255 in the **Offset** edit box or by clicking the up/down buttons until the voltmeter reads 0 V.
6. In the DAC Output Voltage box, select **2.75 V**.
7. Adjust the gain by entering values between 0 and 255 in the **Gain** edit box or by clicking the up/down buttons until the voltmeter reads 2.75 V.
8. Repeat steps 2 to 7 for each analog output channel on the module.

Note: At any time, you can click **Restore Factory Settings** to reset the D/A calibration values to their original factory settings. This process will undo any D/A calibration settings.

Once you have finished this procedure, the analog output circuitry is calibrated. To close the calibration utility, click the close box in the upper right corner of the window.

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Analog Output Specifications. 112
Digital I/O Specifications 113
Trigger Specifications. 114
Power, Physical, and Environmental Specifications 115
Regulatory Specifications 116
Connector Specifications 117

Analog Input Specifications

Table 20 lists the specifications for the analog input subsystem on the DT9847 Series modules

Table 20: Analog Input Subsystem Specifications

Feature	DT9847 Specifications
Number of analog input channels DT9847-1-1: DT9847-2-2: DT9847-3-1:	 1, single-ended 2, single-ended 3, single-ended
Resolution	24 bits
Ranges and gains Gain of 1: Gain of 10:	 ±10 V ±1 V
Gain error Gain of 1: Gain of 10:	 ±0.02% ±0.5%
Gain drift	±150 ppm//° C or 1.5 mV/° C
Offset drift	±10 LSBs//° C or 12 µV/° C
A/D type	Delta-Sigma
Maximum sample rate	216 kHz
Minimum sample rate	1 kHz
Group delay	63/Sample Frequency
Pass band	0.4535 Sample Frequency
Stop band	0.5465 Sample Frequency
Signal/noise	123 dB typical
Total harmonic distortion @50 kHz sample rate (1 kHz input @ –10 dB; 16K FFT) Gain of 1: Gain of 10 (–30 dB input):	 –102.38 dB –101.99 dB
Dynamic range (1 kHz input @ –10 dB; 2.9 V Peak from D/A output) Sampled at 216 kHz: Sampled at 108 kHz: Sampled at 54 kHz:	 118 dB (ENOB = 15.8) 120 dB (ENOB = 16.9) 123 dB (ENOB = 17.1)
Noise Floor at 0 V Input Terminated in 75 Ω Sampled at 216 kHz: Sampled at 108 kHz: Sampled at 54 kHz: Sampled at 10 kHz: Sampled at 1 kHz:	 118 dB (ENOB = 16.2) 120 dB (ENOB = 16.3) 123 dB (ENOB = 16.9) 125 dB (ENOB = 17.4) 127 dB (ENOB = 17.6)

Table 20: Analog Input Subsystem Specifications (cont.)

Feature	DT9847 Specifications
Spurious free dynamic range (SFDR) using a 1 kHz sine wave, sampled at 50 kHz 10 V full-scale signal (-1 dB): 1 V signal (–20 dB): 100 mV signal (–40 dB): 0 V signal: Passband ripple:	 –110 dB typical –100 dB typical –60 dB typical –120 dB typical ±0.001 dB
Spurious free dynamic range (SFDR) using a 1 kHz sine wave, sampled at 100 kHz 10 V full-scale signal (-1 dB): 1 V signal (–20 dB): 100 mV signal (–40 dB): 0 V signal: Passband ripple:	 –110 dB typical –97 dB typical –57 dB typical –120 dB typical ±0.003 dB
Spurious free dynamic range (SFDR) using a 1 kHz sine wave, sampled at 200 kHz 10 V full-scale signal (-1 dB): 1 V signal (–20 dB): 100 mV signal (–40 dB): 0 V signal: Passband ripple:	 –94 dB typical –92 dB typical –52 dB typical –120 dB typical ±0.007 dB
Data encoding	Offset binary
Maximum input voltage (without damage) Power on: Power off:	 ±40 V ±40 V
Input impedance	1 MΩ // 20 pF
Overvoltage protection (power on/off)	±40 V
Current source	4 mA
Compliance voltage	18 V
Current noise @ 1 kHz bandwidth	5 nA rms
Current source accuracy	±1.0%
DC offset	1.5 mV
DC offset AC coupled	±1 mV
Offset TC	±15 µV/° C typical
AC coupling at –3 dB	0.10 Hz
ESD protection Arc: Contact:	 8 kV 4 kV
Warm-up time	1 hour

Figure 25 shows the full system accuracy of the DT9847 Series. In this case, the output of analog output channel 0 is fed into analog input channel 0. The analog output channel is set to ±20 µV at 5 kHz. The analog input channel is sampling at 50 kHz.

Notice that the input is –113.6 dB below full-scale (IBF), the signal-to-noise ratio (S/[N+D]) is –9.12 dB, and the effective number of bits (ENOB) is 17.1. All errors from both subsystems are encompassed into this FFT to show full system dynamic accuracy.

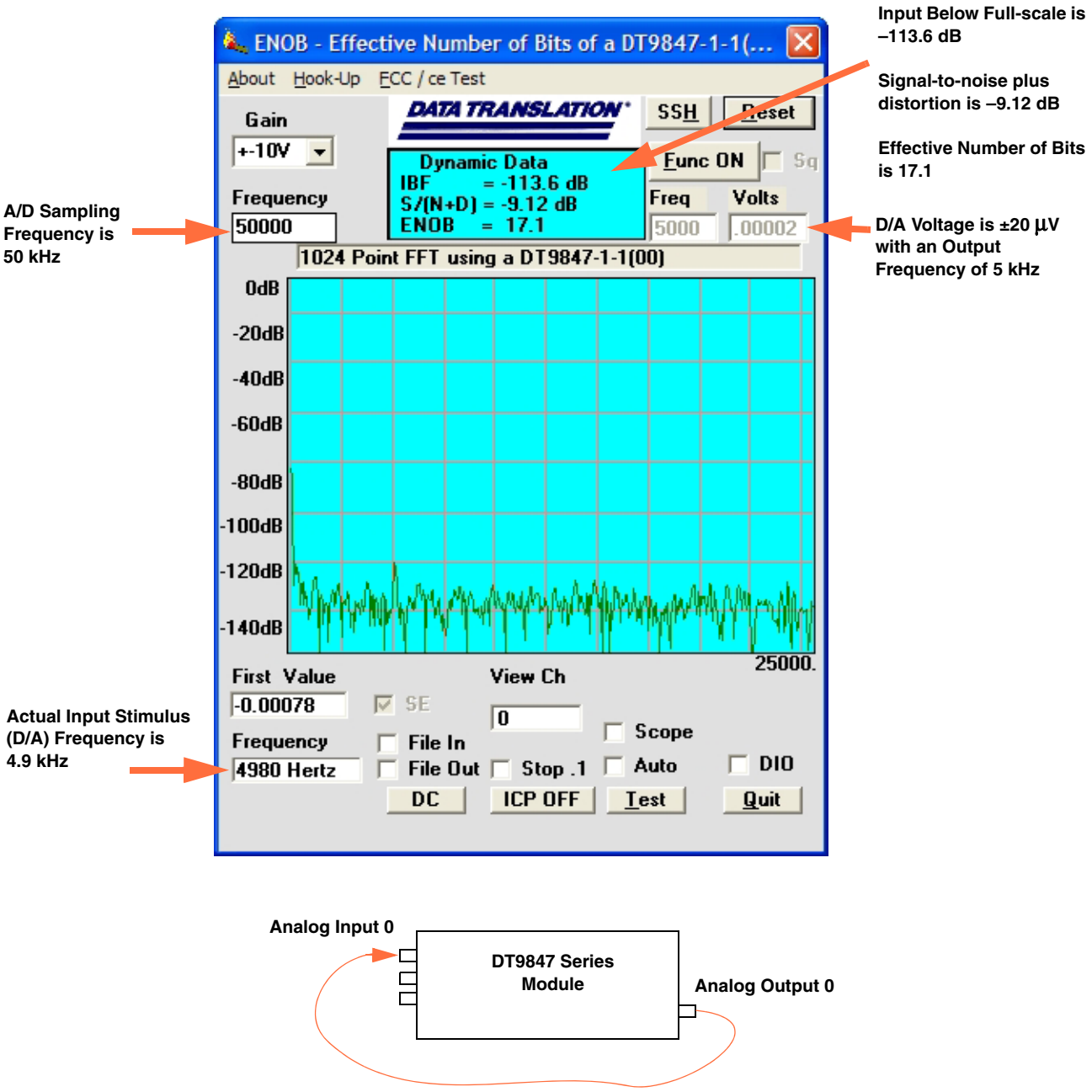


Figure 25: Full System Dynamic Accuracy of the DT9847 Series

Figure 26 shows the result of vector averaging data in VIBpoint Framework. Vector averaging performs mathematical operations in the complex domain. This process cancels non-coherent noise components while allowing coherent signal components to remain.

In this example, a –10 dB input signal is connected to the DT9847 Series and is sampled at 50 kHz. You can clearly see the harmonics pulled out of the noise; the noise floor is below 150 dB.

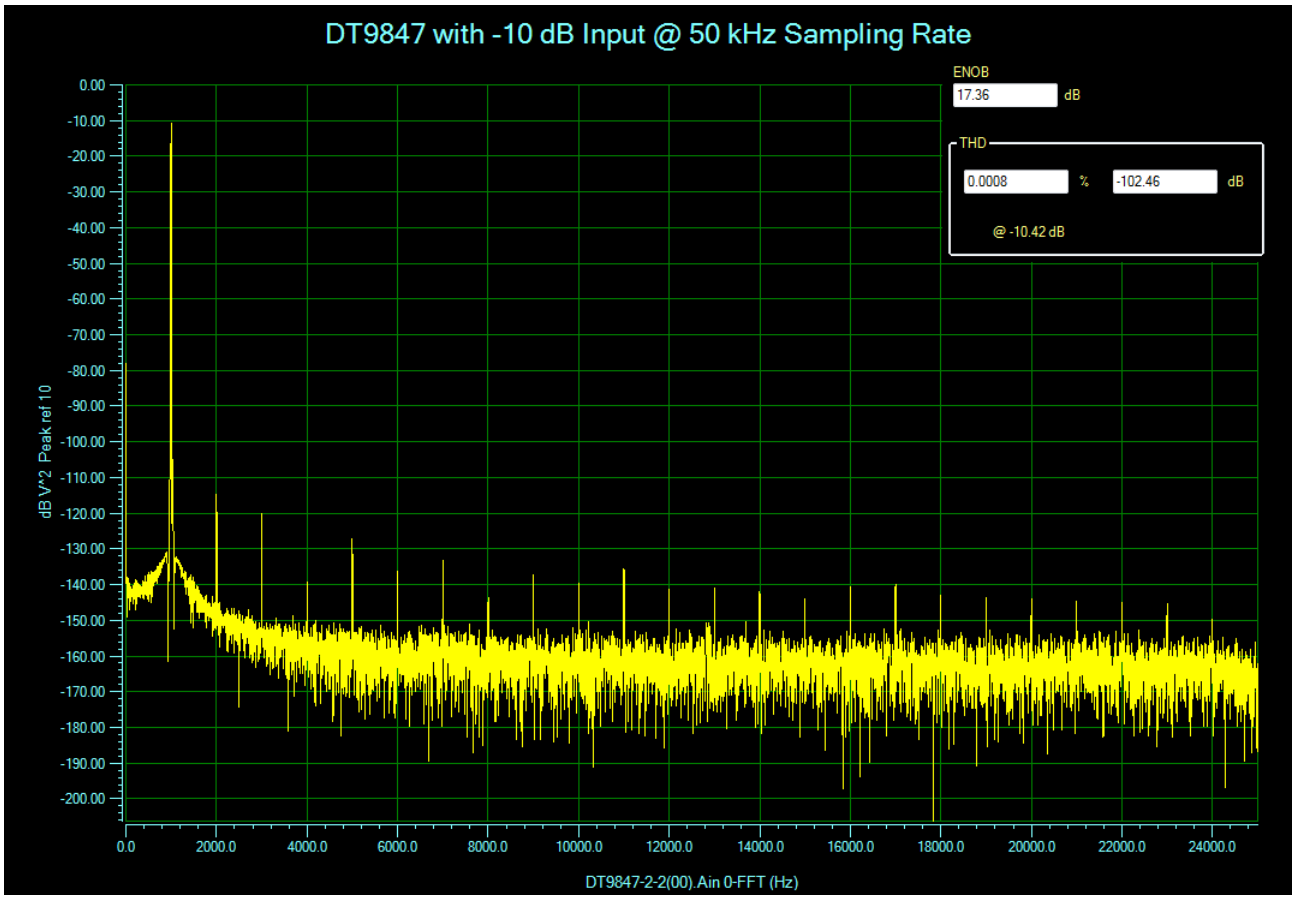


Figure 26: Vector Averaging in VIBpoint Framework Allows Users to Isolate Coherent Signal Components

Analog Output Specifications

Table 21 lists the specifications for the analog output subsystem on the DT9847 Series modules.

Table 21: Analog Output Subsystem Specifications

Feature	DT9847 Series Specifications
Number of analog output channels DT9847-1-1: DT9847-2-2: DT9847-3-1:	 1, single-ended 2, single-ended 1, single-ended
Resolution	32 bits
Output range	±3 V
Data encoding	Offset binary
Output current	±3 mA maximum load (3 V across 1 kΩ)
Output FIFO	8 kSamples
ESD protection Arc: Contact:	 8 kV 4 kV
DC offset	±1 mV
Gain error	±1.0%
Filter	100 kHz, 2-pole, low-pass Butterworth
Time delay (typical)	36/output frequency
Power fault and reset	Goes to 0 V ±10 mV if the USB cable is removed or the power fails
Total harmonic distortion at 50 kHz, typical at 1 kHz: at 100 kHz, typical at 1 kHz: at 200 kHz, typical at 1 kHz:	 –105 dB –102 dB –102 dB
Minimum sample frequency	30 kHz
Maximum sample frequency	216 kHz
Pass band frequency dB ±0.01 dB	0.454 x output frequency
Pass band ripple (typical)	±0.005 dB
Stop band (typical) –100 dB @50 kHz –95 dB @100 kHz –90 dB @200 kHz	0.546 x output frequency

Digital I/O Specifications

Table 22 lists the specifications for the digital I/O subsystems on the DT9847 Series modules.

Table 22: Digital I/O Specifications

Feature	Specifications
Number of digital I/O lines	8 (4 in, 4 out)
Number of ports	2 (4 bits each)
Logic family	LVTTL (5 V tolerant)
Logic sense	Positive true
Inputs Input type: Input logic load: High input voltage: Low input voltage: Low input current: Termination:	 Level-sensitive 1 LVTTL 2.0 V minimum 0.8 V maximum 0.4 mA maximum None
Outputs Fan out: High output: Low output: High output current: Low output current:	 24 mA 2.0 V minimum 0.8 V maximum –12 mA maximum 12 mA maximum
Clocked with sample clock	No
Software I/O selectable	No

Trigger Specifications

Table 23 lists the specifications for the trigger on the DT9847 Series modules.

Table 23: Trigger Specifications

Feature	DT9847 Specifications
Trigger sources Internal software trigger: External digital trigger: Analog threshold trigger:	 Software-initiated Software-selectable Software-selectable
External digital trigger Input type: Logic family: Input logic load: Lower threshold: Upper threshold: Hysteresis: Input sink current: Minimum pulse width high/low: Maximum input signal:	 Edge-sensitive, rising- or falling-edge trigger (software-selectable) LVTTL inputs 1 LVTTL 1.1 V 1.3 V 0.2 V 33 µA 1.3 µA ±30 V
Analog threshold trigger Type: Threshold level: Hysteresis:	 Rising- or falling-edge threshold trigger on any analog input channel (software-selectable) −10 V to +10 V @ gain of 1; ±1 V @ gain of 10 100 mV
Trigger delay	1 conversion period maximum

Power, Physical, and Environmental Specifications

Table 24 lists the power, physical, and environmental specifications for the DT9847 Series modules.

Table 24: Power, Physical, and Environmental Specifications

Feature	DT9847 Series Specifications
Power	
DT9847-1-1:	5 V ±0.30 V@ 600 mA[a]
DT9847-2-2 and DT9847-3-1:	+5 V to 24 V @ 5 W[b]
External Power Supply (EP394)	
Output:	5 V @ 1.6 A
Input voltage:	100 to 240 V AC ±10%
Input current:	250 mA
Frequency:	50 to 60 Hz
Physical Dimensions - Enclosure	
Length:	10.025 inches (254.63 mm)
Width:	4.170 inches (105.92 mm)
Height:	1.575 inches (40 mm)
Weight:	22.62 ounces (641.5 g)
Physical Dimensions - OEM (board only)	
Length:	10.025 inches (254.63 mm)
Width:	3.937 inches (100 mm)
Height:	0.712 inches (18.08 mm)
Weight:	6.5 ounces (184.2 g)
Environmental	
Operating temperature range:	0° C to 55° C
Storage temperature range:	–25° C to 85° C
Relative humidity:	To 95%, noncondensing
Altitude:	To 10,000 feet

a. The DT9847-1-1 requires a USB-Y cable to ensure that adequate power is provided. Refer to page 30 for more information.

b. The EP394 external power supply provides 5 V for the DT9847-2-2 and DT9847-3-1. Refer to page 28 for more information.

Regulatory Specifications

The DT9847 Series is CE-compliant. Table 25 lists the regulatory specifications for the DT9847 Series modules.

Table 25: Regulatory Specifications

Feature	DT9847 Series Specifications
Emissions (EMI)	FCC Part 15, Class A EN55011:2007 (Based on CISPR-11, 2003/A2, 2006)
Immunity	EN61326-1:2006 Electrical Equipment for Measurement, Control, and Laboratory Use EMC Requirements EN61000-4-2:2009 Electrostatic Discharge (ESD) 4 kV contact discharge, 8 kV air discharge, 4 kV horizontal and vertical coupling planes EN61000-4-3:2006 Radiated electromagnetic fields, 3 V/m, 80 to 1000 MHz; 3 V/m, 1.4 GHz to 2 GHz; 1 V/m, 2 GHz to 2.7 GHz EN61000-4-4:2004 Electrical Fast Transient/Burst (EFT) 1 kV on data cables EN61000-4-6:2009 Conducted immunity requirements, 3 Vrms on data cables 150 kHz to 80 MHz
RoHS (EU Directive 2002/95/EG)	Compliant (as of July 1st, 2006)

Connector Specifications

Table 26 lists the connector specifications for the DT9847 Series modules.

Table 26: Connector Specifications

Feature	Specifications
Analog I/O BNC connectors	TE Connectivity 5227161-9
External power supply	Jack on the module: Switchcraft #L722RA Mating plug: Switchcraft #S761K
Sync Bus connector (RJ45)	Molex part number 44661-0001
USB connector	TE Connectivity 292304-2
Digital I/O connector	Kycon K66X-E15S-N

Connector Pin Assignments and LED Status Indicators

Digital I/O and External Trigger Connector 120
External USB Connector 121
External +5 V Connector 122
LED Status Indicators 123

Digital I/O and External Trigger Connector

Figure 27 shows the layout of the 15-pin Digital I/O and External Trigger connector on the DT9847 Series modules.

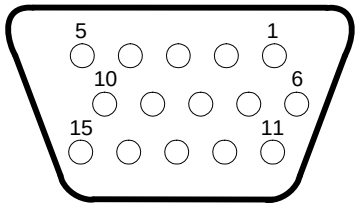


Figure 27: Layout of the Digital I/O and External Trigger Connector

Table 27 lists the pin assignments for the Digital I/O and External Trigger connector on the DT9847 Series modules.

Table 27: Pin Assignments for the Digital I/O and External Trigger Connector on the DT9847 Series Modules

Connector Pin Number	Signal Description
1	Digital Input 0
2	Digital Input 1
3	Digital Input 2
4	Digital Input 3
5	Ground
6	Digital Output 0
7	Digital Output 1
8	Digital Output 2
9	No Connect
10	Ground
11	Digital Output 3
12	No Connect
13	External Trigger
14	No Connect
15	Ground

External USB Connector

Figure 28 shows the layout of the external USB connector on the DT9847 Series modules.

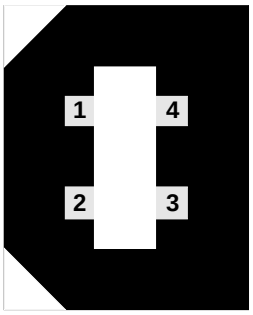


Figure 28: Layout of the USB Connector

Table 28 lists the pin assignments for the USB connector on the DT9847 Series modules.

Table 28: Pin Assignments for the USB Connector on the DT9847 Series Modules

Connector Pin Number	Signal Description	Connector Pin Number	Signal Description
1	USB +5 V	3	USB Data +
2	USB Data –	4	USB Ground

External +5 V Connector

Figure 29 shows the layout of the external +5 V connector on the DT9847-2-2 and DT9847-3-1 modules. Note that the DT9847-1-1 module operates on USB power; therefore, this connector is not used on that module.

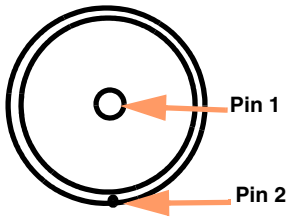


Figure 29: Layout of the External +5 V Connector

Table 29 lists the pin assignments for the external +5 V connector on the DT9847-2-2 and DT9847-3-1 modules.

Table 29: Pin Assignments for the External +5 V Connector on the DT9847-2-2 and DT9847-3-1 Modules

Connector Pin Number	Signal Description
1	+5 V
2	Ground

LED Status Indicators

The DT9847 Series has a two bi-color LEDs on the module, shown in Figure 30.

Figure 30: LEDs on DT9847 Series Modules

These LEDs are described in Table 30.

Table 30: LED Status Indicators on the DT9847 Series Modules

LED	Color of the LED	Status Description
USB LED	Green	Module is powered
	Blinking amber	Module is active (acquiring data from the analog input channels or streaming data to the analog output channels in continuous mode)[a]
Trigger LED	Green	Module is armed; it is waiting for an external digital trigger, threshold trigger, or Sync Bus trigger (the module must have been configured for one of these trigger types)
	Red	Module has been triggered

a. When only waveform analog output operations are in progress, this LED is not lit because this operation does not require USB activity.

Powering OEM Modules

Powering the DT9847-1-1-OEM Module 126
Powering the DT9847-2-2-OEM or DT9847-3-1-OEM Module 127

Powering the DT9847-1-1-OEM Module

The DT9847-1-1-OEM module can be powered with USB power using the EP399 USB-Y cable, as shown in page 29.

By default, jumper W5, shown in Figure 31, is installed on the module when it is shipped from the factory to select USB power. (This jumper is near the analog output connector on the module.)

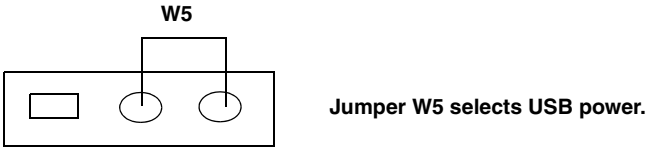


Figure 31: Installing Jumper W5 to Select USB Power

Optionally, you can use an external +5 V power supply to power the DT9847-1-1-OEM module. To use external power, do the following:

1. Remove jumper W5 and install jumper W4 on the module, as shown in Figure 32. (This jumper is near the analog output connector on the module.)

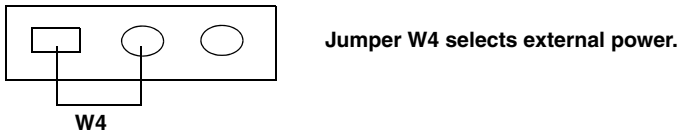


Figure 32: Installing Jumper W4 to Select External Power

2. Connect an external power supply to the three-position screw terminal block (TB1) on the module, as shown in Figure 33. (TB1 is near the analog output connector on the module.)

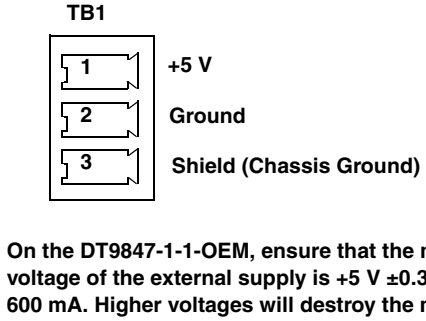
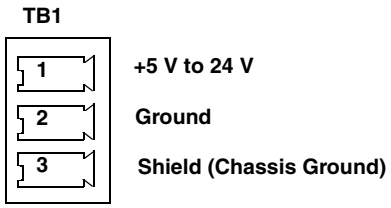

TB1
1
2
3
+5 V
Ground
Shield (Chassis Ground)
On the DT9847-1-1-OEM, ensure that the maximum voltage of the external supply is +5 V ±0.30 V @ 600 mA. Higher voltages will destroy the module.

Figure 33: Connecting an External Power Supply to Screw Terminal TB1 on the Module

Powering the DT9847-2-2-OEM or DT9847-3-1-OEM Module

The DT9847-2-2-OEM or DT9847-3-1-OEM module must be externally powered with a +5 V to 24 V @ 5 W power supply.

You can connect an external power supply either to the barrel power connector on the module, as shown on page 28, or to the three-position screw terminal block (TB1) on the module, as shown in Figure 34.



The DT9847-2-2-OEM and DT9847-3-1-OEM modules accept an +5 V to 24 V @ 5 W external power supply.

Figure 34: Connecting an External Power Supply to Screw Terminal TB1 on the Module

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